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ENGINEERING AND MINING JOURNAL-PRESS

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Pachuca: Home of the Patio Process

By Blair Burwell

Commercial Possibilities of the Magnetite Slates of the Cuyuna Range

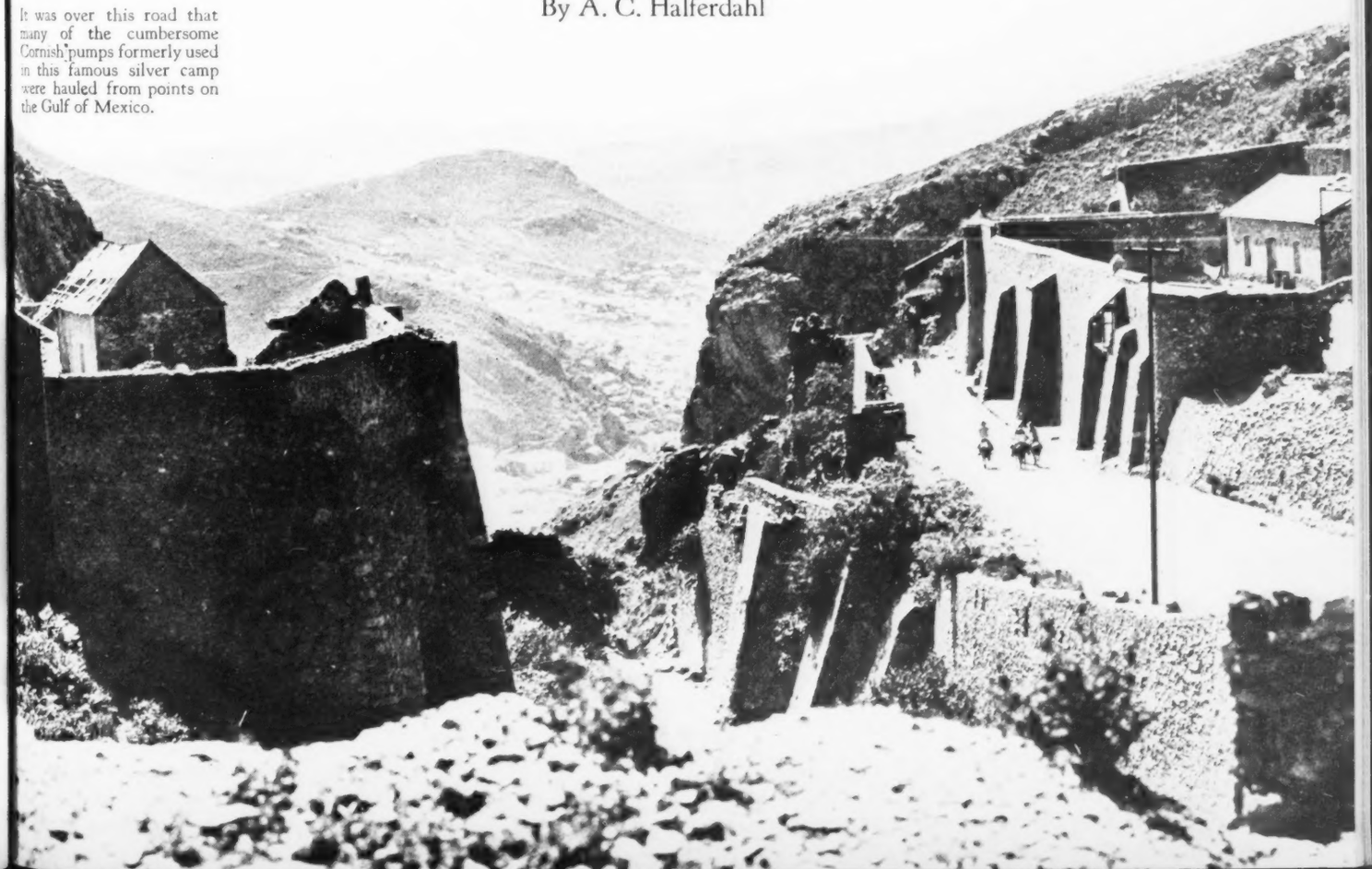
By George A. Thiel

Prospecting by Radio

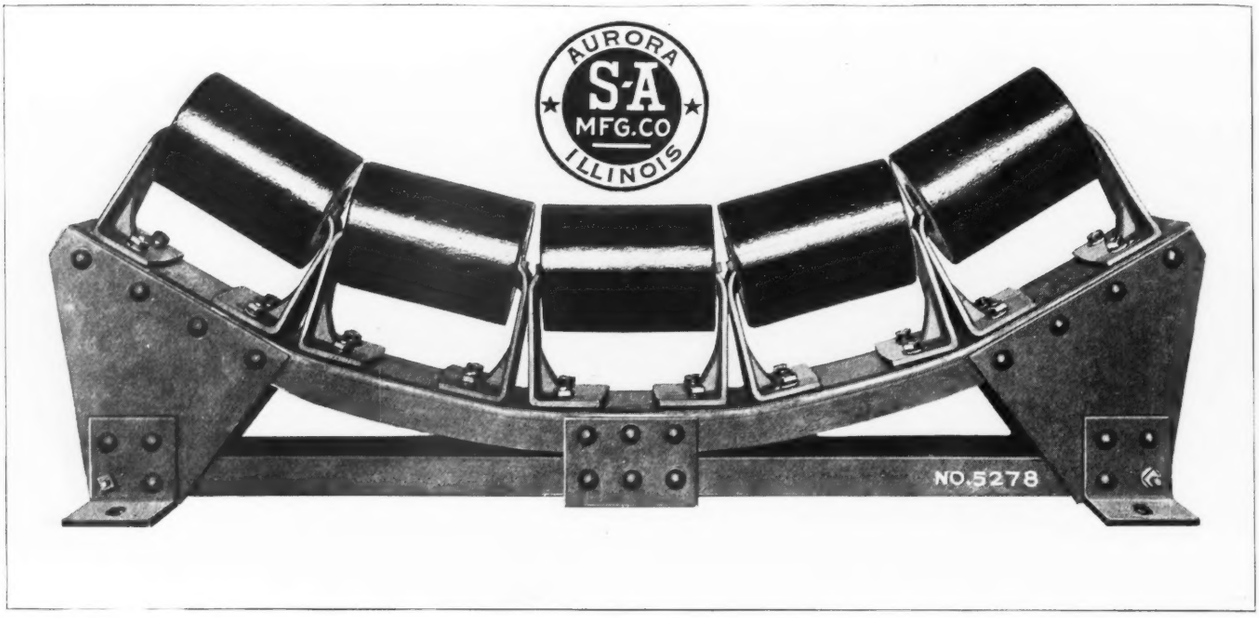
By Wilbur C. Riley

Accuracy in Sampling Metallurgical Materials

By A. C. Halferdahl



It was over this road that many of the cumbersome Cornish pumps formerly used in this famous silver camp were hauled from points on the Gulf of Mexico.



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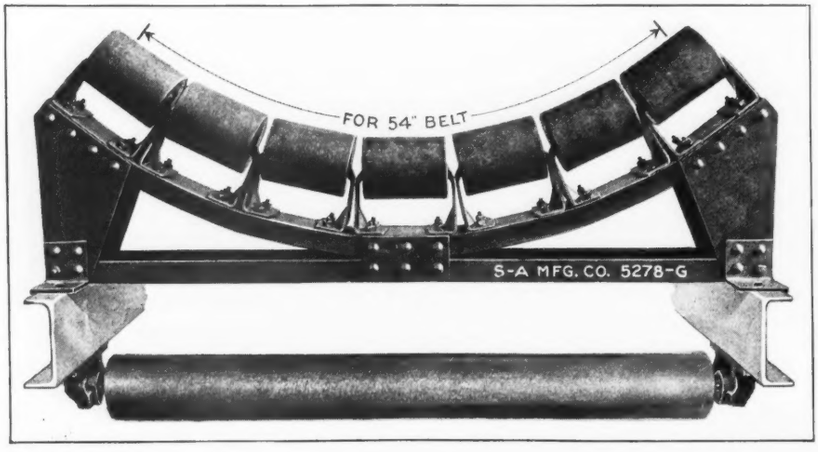

ENGINEERING AND
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JOSIAH EDWARD SPURR, Editor

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Gold from Mercury

THE REPUTED TRANSMUTATION of mercury to gold by Dr. Miethe, of Berlin, was reported in the daily press during the past summer and was investigated by us through our Berlin correspondent, Dr. James Rubinfeld. We ascertained that Dr. Miethe was a man of good standing in the scientific and technical world, but beyond that, no evidence has come to our attention as to whether the discovery was real. Even scientists and technologists sometimes err in interpreting their experiments. Also, in our edition of Oct. 18, we commented on a newspaper mention of the alleged change of mercury into gold, in which the feat was obscurely referred to a Japanese scientist. This reference to a "Japanese doctor" instead of a "German doctor" we believed to belong to the common type of newspaper error. We are indebted to our good friend Dr. E. P. Mathewson for setting us right, by transmitting to us a letter and a clipping from Japan. From this we learn that Dr. H. Nagaoka has reported that he has obtained gold from mercury, after fifteen years' investigation. Dr. Nagaoka is a worker in the government laboratory of science at Tokio. The Tokio *Nichi-Nichi*, of Sept. 24, 1924, reports the discovery, stating that the present quantity obtained is said to be about 1/10,000 part of the quantity of mercury. This coincides in general with the nature of the results obtained by Dr. Miethe in Germany. The announcement from two countries so nearly simultaneously strengthens the possibility of a real discovery. Nevertheless, opinion regarding it should be withheld. As we noted in our editorial of Aug. 16, mercury almost invariably contains a small impurity of gold, the proportion of which coincides in a general way with the amount of gold held to have been formed by transmutation by the scientists in Berlin and in Tokio. If the discovery is genuine, it should be noted that Dr. Nagaoka claims priority. The Tokio *Nichi-Nichi* comments as follows:

"For some years past, the structure of the spectral lines of mercury was minutely examined at the Institute, and an abstract of the principal results published in 'Nature' of May 9, 1924. Among the different conclusions, Nagaoka, Sugiura, and Mishima stated that if the hypothesis as regards the nucleus of the mercury atom, advanced for explaining the structure of the lines, be valid, we can probably fulfill the dream of alchemists, by striking it with swiftly moving particles, or by some other powerful means of disruption. In July, Dr. A. Miethe announced the discovery of gold from a residue in a mercury lamp. Owing to the small quantity of the material, the question of the transmutation left many problems still unsolved.

"Having recourse neither to a mercury lamp nor to particles, Nagaoka, Sugirua, and Asada applied the method of powerful disruption to effect the transmutation, and obtained a good result from the first trial. The details of the method are at present reserved. The samples were examined by Mr. M. Yasuda, expert in gold assaying, who obtained many fine globules of gold and patches of gold film at the bottom of a dish, showing the brilliant lustre of the metal. Chemical tests for gold were positive. From the quantity obtained by rough trial experiments, there is a dim prospect of giving rise to an industrial undertaking in the future.

"The method is perhaps applicable to other elements, which will likewise show various changes. The conception of chemical elements is shaken from its foundation, and the effect is of greatest importance to present-day chemistry and physics.

"Probably many hitherto unknown elements will be produced artificially. The experiment is but a stepping stone to further research for adding new knowledge and for elucidating many difficult problems, concerning the atoms. If the method of changing mercury into gold be economically developed in the future, the problems that will follow are outside the domain of the present communication."

Efficient Electrical Machinery

DURING THE PRESENT YEAR the Utah Copper Co. concluded, in part at least, an interesting comparison of direct-current and alternating-current electrical machinery as applied to power shovels in open-pit mining. Two of these shovels were electrically equipped, one with direct-current and the other with alternating-current motors. Exhaustive tests were made under operating conditions. The result has been a decision to equip the other shovels with alternating-current machinery. Electrical equipment for operating steam shovels is undoubtedly superior to steam equipment. The gold-dredge operators long ago reached a similar decision, and alternating-current motors have proved to be effective in this heavy work.

It is of interest to note that the Chile Exploration Co., operating the Chuquicamata mine, in Chile, has used shovels equipped with alternating-current motors since 1919, but new shovels now under order are to be operated by direct current. Thus we have the interesting comparison of two large mining companies, both operating large open pits by the bench system, diverging in opinion on the subject of the most efficient kind of electrical drive. A hasty comparison of conditions at either mine fails to bring out any point of marked difference that would indicate that local conditions had been a predominating factor in the selection of either type of equipment. As a consequence we conclude that the differences in the performance of both types of equipment are very small and that both types have given exceptionally good service. This, in our opinion, is conclusive evidence of the excellence of modern electrical machinery under severe operating conditions. Like the gold dredge, the electrically operated shovel is now standard equipment, both in its electrical and its digging features.

Salt for Fatigued Miners

MORE than one miner who finds himself much wearied after putting in a shift in a warm, badly ventilated working might be persuaded to try an experiment that is described by Sir Josiah Court in a paper read before the Institution of Mining

Engineers, in London, on Oct. 2. The experiment involves simply the drinking of a weak solution of salt in water from time to time during the course of the day, a teaspoonful of salt being added to a quart of water in the experiments described. The miners who made the test usually drank two quarts each of this solution during the shift.

Court, it seems, had previously read a paper by Prof. K. Neville Moss, of the University of Birmingham, in which Professor Moss said that he had observed that men working in hot mines under a temperature varying from 98 to 102 deg. F. (dry bulb) suffered from fatigue and occasional attacks of cramp. The evidence was submitted to Dr. J. S. Haldane, who suggested that the cramp might have been caused by excessive loss of sodium chloride due to profuse and prolonged sweating, with the drinking of much water. It was decided to see what the effect of drinking a weak solution of salt in water would be on a few colliers at work. In this original test the proportion of salt used was about 10 grams per gallon of water. The results were found to justify the use of the water in cases of excessive sweating.

The account of this experiment led Court to make the test for himself in a colliery where he had heard the working temperature was high. Interviewing six miners, he found that they were working in air temperatures of 79 to 81 deg. F. Each of them consented to take his advice and put salt in the drinking water which he brought to the pit. Each miner took to work with him a tin can holding four pints of water containing a teaspoonful of salt per quart, the salt being added at home. The results, the experimenter reports, were gratifying. After a month's trial they all said they were less tired after their work. Their wives said that they were more energetic on arriving home. A similar experiment lasting seven weeks was made with boiler men working in an average temperature of 96 deg. F. (dry), with equally good results.

Many a mine has, in part of its workings at least, a temperature that is uncomfortably high. In several cases that we have known of, three or four hours have constituted a shift in certain stopes because of this condition. The experiment with the salt solution might be tried with profit.

Fine Grinding Gold in the All-Slime Process

THE INTRODUCTION of the "new metallurgy" of the Witwatersrand involves the fine grinding of the gold as well as the gangue, a problem that has received scant attention previous to the research by K. L. Graham and F. Wartenweiler, the results of which were published recently by the Institution of Mining and Metallurgy. The authors of the paper state that the problem is to determine "to what state of division the gold must be broken up, or ground, in order to insure that it is dissolved in the available time of cyanide treatment; or, conversely, what methods of cyanide extraction must be employed to dissolve the gold of different sizes." The results are highly educative, the conclusions, by the way, being illustrated by excellent photomicrographs, not microphotographs, as stated. The comparison made between the free, amalgamable gold caught on corduroy blankets at the mortar-box discharge and that caught by a similar method in the tube-mill circuit is illustrative of the comminution occurring in an all-sliming plant, which may, however, be insufficient. The precise mechanism of the reduction in size is unimportant. The question of moment is: What are the relative solubilities of the various sizes? All-slime agitation and sand-leaching tests were made to provide the data sought. Only the minus 260-mesh gold gave a high extraction in the limited time available by the one-product method—all-slime treatment—the figures after eight hours' agitation being as follows: Modderfontein East and Robinson Gold, 99.4 per cent; New Modderfontein gold, 86.7 per cent. The extraction of gold from all sizes coarser than minus 260 mesh appears to have been uniformly unsatisfactory. The residue from minus 260 plus 200 mesh Robinson gold was 1.66 dwt. after eight hours' agitation and 1.64 dwt. after sixteen hours' agitation, an increase of only 0.4 per cent. Particles of Modderfontein East gold of the same size were dissolved at the rate of 59 per cent in the first eight hours, the extraction reaching only 66.4 per cent after sixteen hours. Experiments with New Modderfontein gold, minus 90 plus 200 mesh, were apparently stopped after eight hours, and after an extraction of only 39 per cent had been observed.

By leaching treatment with fine sand, the results on all but the coarsest particles, easily recoverable by amalgamation, were excellent: minus 260 mesh gold, 100 per cent in four days; minus 200 plus 260 mesh gold, 100 per cent in four days; minus 90 plus 200 mesh gold, 100 per cent in five days; minus 60 plus 90 mesh gold, 98.7 per cent in seven days; plus 60 mesh gold, 80.4 per cent in seven days. Thus, only a fair extraction was obtained from the coarsest particles, as might be expected. For sand leaching, the authors recommend uniform grinding to 60 mesh, or the abstraction of the oversize gold by mechanical treatment prior to cyaniding. Blanketing and amalgamation are indicated. It would obviously be illogical to attempt to cyanide particles of coarse gold.

For the short one-pulp treatment, it is recommended that all the gold be ground to minus 260 mesh; but no attention is directed to the important fact that this will involve the grinding of the gangue or ore to the same mesh. The density of the pulp in the tube-mill circuit is such that no advantage can be taken, by gravitational classification and return to the mill, of the difference in specific gravity between the gold and the gangue when such minute dimensions have been reached. For every 0.0017 lb. of gold present, 1,999.9983 lb. of gangue or ore must be ground to this extremely fine state of subdivision. Is the game worth the candle? There seems to be no alternative to this excessive fine grinding as a necessary preliminary to satisfactory extraction by the all-slime method. Not only must the expense of this be taken into consideration, but also the decreased efficiency of the solution-displacement method that follows for the purpose of separating the dissolved gold from worthless residue.

When ore is ground extremely fine it is probable that the difficulties arising from small particle size are aggravated by the development of colloidal characteristics. Assuming the correctness of the research and the logic of the conclusions reached by the authors—that extremely fine grinding is necessary—what are the advantages of all-sliming in preference to leaching, as indicated by the results of the tests? Is the additional grinding, to adapt the gold and the gangue for a hurried agitation treatment, justified by results, economic or

metallurgical? The cost and efficiency of solution recovery from finely divided gangue is a phase of operations that is often overlooked by those making tests to determine the "extraction" of gold by an all-slime, agitation treatment, especially when comparing results with those obtainable by the leaching of a sand that is easily and efficiently washed of valuable solution. It is recognized that the research in question refers to a particular and local problem, and that the gold used in the tests may not represent the condition of all the gold in the ore after comminution; but the conclusions should have a far-reaching influence on metallurgical thought, and it is desirable to recognize the effect they may have on the formulation of basic economic principles. The authors' conclusions are unsatisfying. They set out, *inter alia*, to find out "what method of cyanide extraction must be employed to dissolve the gold of different sizes"; their comments avoid a decision by stating that *if* all-sliming be adopted it is necessary to grind the ore extremely fine; *if* leaching be adopted the pulp should be ground to pass 60 mesh, or the coarse gold should be recovered by other means prior to cyanidation, which contributes little to present-day knowledge.

The present discussion is timely, as directing attention to a subject that merits more research and discussion than has been accorded to it. The advantages of cyaniding a sand that has been ground comparatively fine, but not approximating the fineness needed for a hurried treatment by agitation, have long been recognized by Rand metallurgists. Elsewhere, however, many instances have been reported where leaching tests have been abandoned after an experimental trial with 20- or 30-mesh material, and all-sliming, the other extreme, has been adopted as the only alternative.

Income Tax Publicity

WHETHER or not the making public of income tax figures was a mistake we do not know. We are not disposed to get heated up about it either way. Publicity and frankness, as principles, are wholesome: and while it is decent to conceal many things, the characterization of the baring of income tax figures as indecent is open to debate. One beneficial result it may have, as Judge Gary remarked—to make it clear and striking how the income tax law fails to tax the incomes of many of the richest men, who put their fortunes into tax-exempt securities, and cheerfully step out from under the burden of government support by taxation. For example, we note that while John D. Rockefeller, Jr., paid $7,435,169.11 federal income taxes in 1923, John D. Rockefeller, Sr., paid only $124,266.47. The difference is perhaps not so much that the son has more sense of public obligation than the father as that the latter has retired from business, and draws his income from tax-exempt bonds, while the former draws his from dividends.

Turning to the legendary multi-millionaires of New York, we note that Cornelius Vanderbilt, Jr., paid $3,100.99; and Cornelius Vanderbilt, $1,111.85; the estate of Alfred G. Vanderbilt, $304! These are very typical instances. In the lists also which the newspapers publish, one may note the names of those who are working hard and becoming successful, with considerable current incomes, who are peeling enormous slices off of their annual incomes to satisfy the tax law. Calvin Coolidge strips off from his presidential salary of $75,000, $6,643 for the government expenses. If the public, and Congress, will study this situation, they will remember with respect the urgings of Secretary Mellon that the issuance of tax-exempt securities be stopped. Mr. Mellon himself makes a brave showing with a personal income tax of $1,173,987. Very possibly this is largely due to his ownership in the Aluminum Company of America, which naturally pays its profits in dividends, which are taxable. At any rate, his words were words of wisdom.

The present income tax law is unutterably stupid and unjust, in that it selects the middle class for exploitation and practically exempts most of the large incomes as well as the smaller. It was said of England that she is froth at the top, dregs at the bottom, and good ale in the middle. The tendency of the income tax law is to convert the good ale either into froth or dregs.

In this analysis it would be a mistake to attach any blame to the rich man or woman who puts his fortune into tax-exempt securities and so drops off the government's taxable list. The Federal Government and the state and the municipality are all begging him to do exactly this. They press their tax-exempt bonds on him for investment. In buying them he is heeding a government urge and a government law quite as much as when he makes out his income tax statement. He would be unworldly and even unpractical if he did not make the distribution of his funds between these governmental urgings as seemed best to him personally.

Brines of Searles Lake

THE PROMOTION METHODS of the Burnham Chemical Co. (which for some years has been selling its stock to exploit a process for recovering the valuable salts from the brine of Searles Lake, in California) were severely scored recently in *Chemical and Metallurgical Engineering*, by the editor of that journal. The editor says:

"*Chem. & Met.* has been favored with a full line of Burnham promotion circulars since 1922. As a series of appeals to credulity and follow-ups on cupidity they exceed any campaign which has come to our notice."

Summarizing the campaign the editor remarks:

"Mr. Burnham is persistent and doubtless sincere, but suspicion prevails that he is a better promoter than technologist, and that his project is not a desirable investment for people of ordinary means. The company's funds should be diverted from the production of newspapers and promotion literature to research and development along sound technical lines. Until that policy is adopted, and reasonable prospects of success are assured, investors are well advised to scratch the Burnham Co. off their list."

There is an epidemic of advertisers and promoters who have learned in an elementary way to appeal to mob psychology. They have been taught that one of the most universal primitive instincts is greed; and that if they appeal to that directly and crassly, the results will be far greater than if they appeal to the intellect. Granting that this is on the whole true, it is also true that no fine or scrupulous nature can undertake to exploit mankind through any one of his baser instincts or passions. There are a number of promoters of the stock of metal mines who have frankly and cold-bloodedly adopted this policy; and they report that it works. It remains to be seen what the closing chapter of the tale is. "The mills of God grind slowly, yet they grind exceeding small." None of the projects which have been financed by the conscious manipulation of greedy suckers has yet come to success.

Reviving Early Days in California

During the recent meeting of the American Mining Congress at Sacramento, scenes of the days of '49 were re-enacted. In Auburn Ravine some of the old Chinese gold miners got out their rockers and played a part in the show.

Below—Some of the gold washers rigged up an old Chinese pump

Above—After many adjustments the pump was finally persuaded to work

Mining Camps of North America

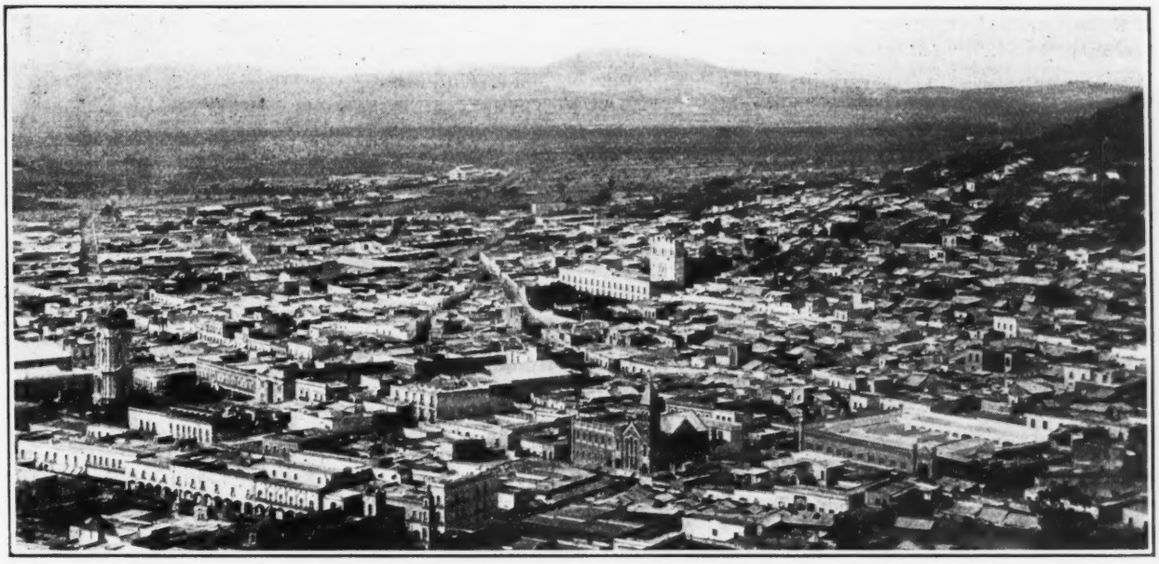
Pachuca: Home of the Patio Process

Worked by Spaniards in 1522, Now the World's Largest Producer of Silver

By Blair Burwell
Mining Engineer, Pachuca, Hidalgo, Mexico

PACHUCA, one of the oldest mining camps in Mexico, today is producing more silver than any other district in the world. Its present production is more than 2,000,000 oz. of silver and 10,000 oz. of gold per month.

The town of Pachuca, with a population of possibly 50,000 inhabitants, lies north and east of Mexico City, at a distance of 100 km. Three railroads reach the town from Mexico City, giving a connection with the seaports of Vera Cruz and Tampico. Hydro-electric power is available from the Mexican Light & Power Co. The region combines to an unusual extent a rich and well-mineralized district with the advantages of easy accessibility.



The old city of Pachuca

The district covers what is known as the Sierra de Pachuca, the crests of which, rising to elevations between 9,000 and 10,000 ft., form a continental divide between the high interior valley of Mexico and the Tierra Caliente of the east coast. Pachuca, at an elevation of 8,000 ft., lies on the south side of this sierra, from which the other parts of the region are reached. The south side has the cool and somewhat arid climate of the Mexican plateau; the north side is heavily wooded with oaks and firs, and has a heavy rainfall. The change between the bare *maguey*-dotted hills of the south side and the forests of the north takes place abruptly at the divide.

The history of the region is rich in the romance of early mining in Mexico. The ancient walls that surround the patio in which Bartolome de Medina perfected the patio process in 1557 echo the roar of a modern 2,000-ton mill; and liquid oxygen explosives are completing the work begun by the Spanish conquerors in some of the first mines in Mexico.

Probably Worked by the Aztecs

The early history of the old camps of Mexico is usually fragmental and uncertain. Pachuca was reputed to have been worked by the Aztecs and to have been discovered by the Spaniards about 1522. The proximity to the City of Mexico undoubtedly was a factor in its early exploitation. The patio process was developed here in 1557, and in the sixteenth and seventeenth centuries the region contributed largely to the wealth that Spain drew from Mexico.

Patios Treated 30-Oz. Ore

In time the workings on the surface bonanzas attained depth, and the inability of the old-time miners to handle water in deep workings resulted in a decline which continued until 1824, when an English company was formed by the Count of Regla. After a disastrous failure and reorganization in 1848, this company opened up the Rosario bonanza, north of town. About this time a number of Cornish miners were brought into the camp and the huge masonry buildings which housed the Cornish pumps and the sloping thatched roofs of the Real Del Monte villages suggested the appearance as well as the reputation of Cornwall.

The discovery of the Santa Gertrudis and San Rafael bonanzas, about 1875, pushed the district into the first rank of Mexican producers. At this time only ore of a

grade of 30 oz. or better was mined, ore of this grade going to the patios for treatment; the higher grade ore was shipped to the smelters of the United States or in Europe.

Cyanide Process Introduced in 1908

The purchase of the Real Del Monte y Pachuca Co. by the United States Smelting, Refining & Mining Co. and the introduction of the cyanide process marks the beginning of the modern era in the district. In 1908 this company completed the Guerrero mill, with an initial capacity of 350 tons per day. The Loreto mill, in Pachuca, had been previously changed from amalgamation to cyanide. In 1909 the San Rafael mill went into operation with a daily tonnage of 400, and about the same time the Maravillas and the La Blanca mills were completed, with capacities of 400 and 500 tons. In 1911 the Santa Gertrudis mill went into operation, with capacity to handle 1,100 tons per day.

The known mineralized region covers an area about twelve miles long and ten miles wide. This area is composed of a number of smaller districts, which are interrelated as to their geological features but separated as to accessibility. The Pachuca district proper covers the veins in the vicinity of the town. The Real Del Monte district lies to the east on the eastward extension of the Pachuca veins and on the north-south series developed in the eastern portion of the district. The El Chico district, to the north and on the other side of the divide from Pachuca, and the Capula and Santa Rosa districts form the western border of the area. Of these districts, the Pachuca and Real Del Monte sections are to be credited with the bulk of present production. The smaller districts are in a comparatively undeveloped condition.

Geology Typical of Great Tertiary Bonanzas

The Sierra de Pachuca, in which the extensive vein systems are found, is made up of a thick series of Tertiary eruptives. Exposed over the greatest portion of the region is a series of andesites, dacites, and andesite porphyry, which are locally known as the older andesites. In these pyroxene andesites are found the producing veins of the district.

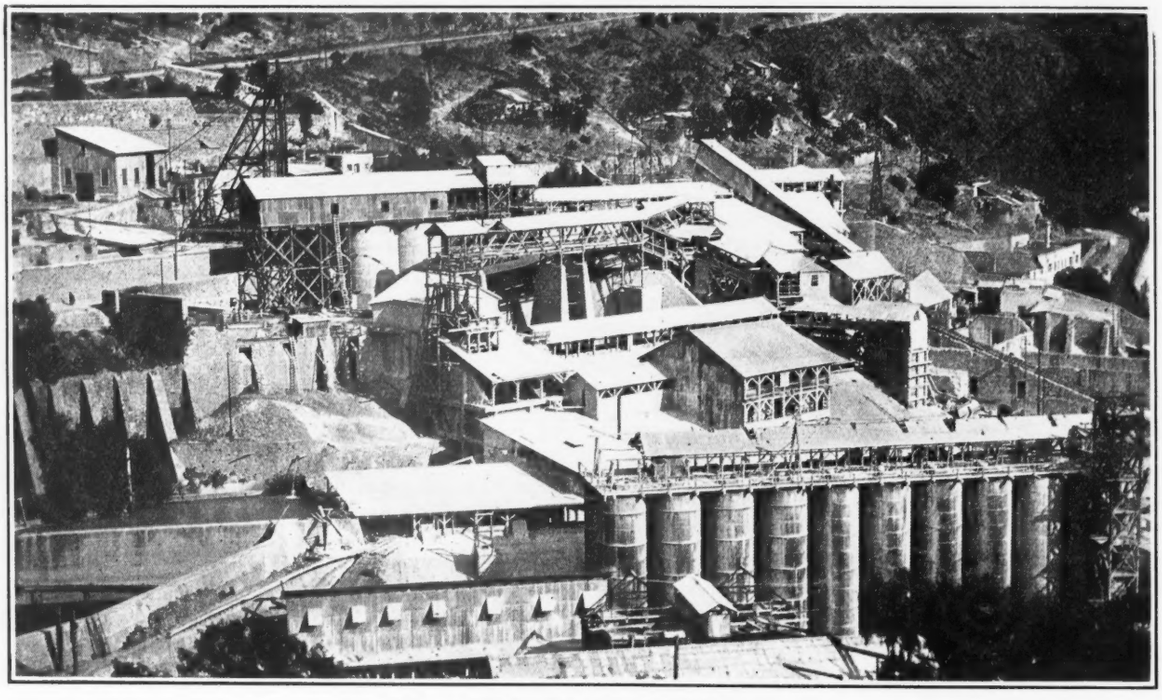
In the central part of the district, and forming the backbone of the divide, are found another and similar series of andesites and dacites which are called the younger andesites. These andesites are probably a product of the same parent magma as the older andesites, and fill a basin in the older andesites. The younger andesites have covered the vein outcrops in this part, although a secondary movement in the vein fracture has in some cases extended upward through the younger andesite, resulting in a false outcrop.

Cutting both series are rhyolite and quartz porphyry dikes, following in some occurrences the same directional lines of weakness as the vein systems. Rhyolite flows and tuffs of minor importance complete the series.

The veins are essentially impregnations and replacements in shattered and altered fault zones. Three main groupings may be made from a directional standpoint: a main southeasterly striking series; a group of secondary branch veins which join the first series at angles varying around 30 deg. and form a link structure with them; and lastly a north-south series developed in the Real Del Monte district. See page 729.

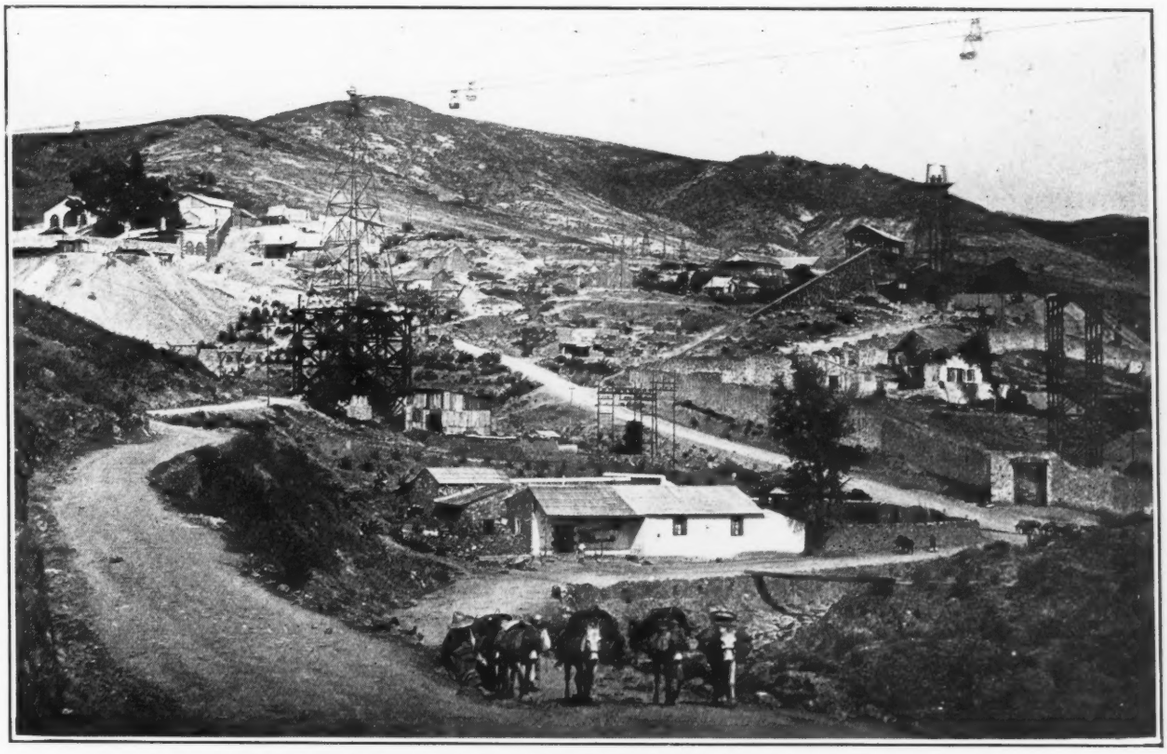
Argentite Principal Silver Mineral

The vein filling is mainly fractured, altered, and silicified andesite with quartz, and a minor amount of calcite. Manganese is found as the oxide, carbonate, and silicate and sometimes forms refractory ore, although the presence of manganese does not always indicate a refractory combination. The principal silver mineral is argentite, with occasional native silver and more rarely the chlorides and the bromides. A small amount of other base sulphides is found. Usually the



Loreto mill of the Real Del Monte

Note the tall agitators in the foreground. The "Pachuca" tank originated here.



Santa Ursula shaft, at the Santa Ana mine

The pack train in the foreground contrasts with the aërial tram and its steel towers above

presence of visible sulphides indicates high-grade ore. Gold is present with an average ratio of 1 oz. to 500 of silver.

In their horizontal extent the orebodies grade out into fault zones. For this reason, faults cut in exploratory work are of interest as possible veins.

The orebodies vary greatly in size. The most important developed are those of the Santa Gertrudis and San Rafael. The oreshoot in the joining Santa Ana, San Rafael and Camelia mines on the Vizcaina vein extends for 6,000 ft., with an average stoping width between 5 and 50 ft. This vein has produced 73,000,000 oz. of silver in the limits of the San Rafael mine alone, and its total production is probably in excess of 200,000,000 oz. The total production of the district up to 1902 is given by Ezequil Ordonez as 3,500 metric tons of silver (*Trans. A. I. M. E.*, Vol. 32, 1902), and its production since that time has probably increased this to more than 10,000 metric tons.

Veins Barren Below 2,000 Ft.

In depth the orebodies seem to be fairly definitely limited between 1,500 and 2,000 ft., although fingering extensions are found somewhat deeper than the main body. Below this depth exploration has revealed a well-defined vein, but barren or with low values. In general, the horizontal extent of the orebodies is two or three times the vertical.

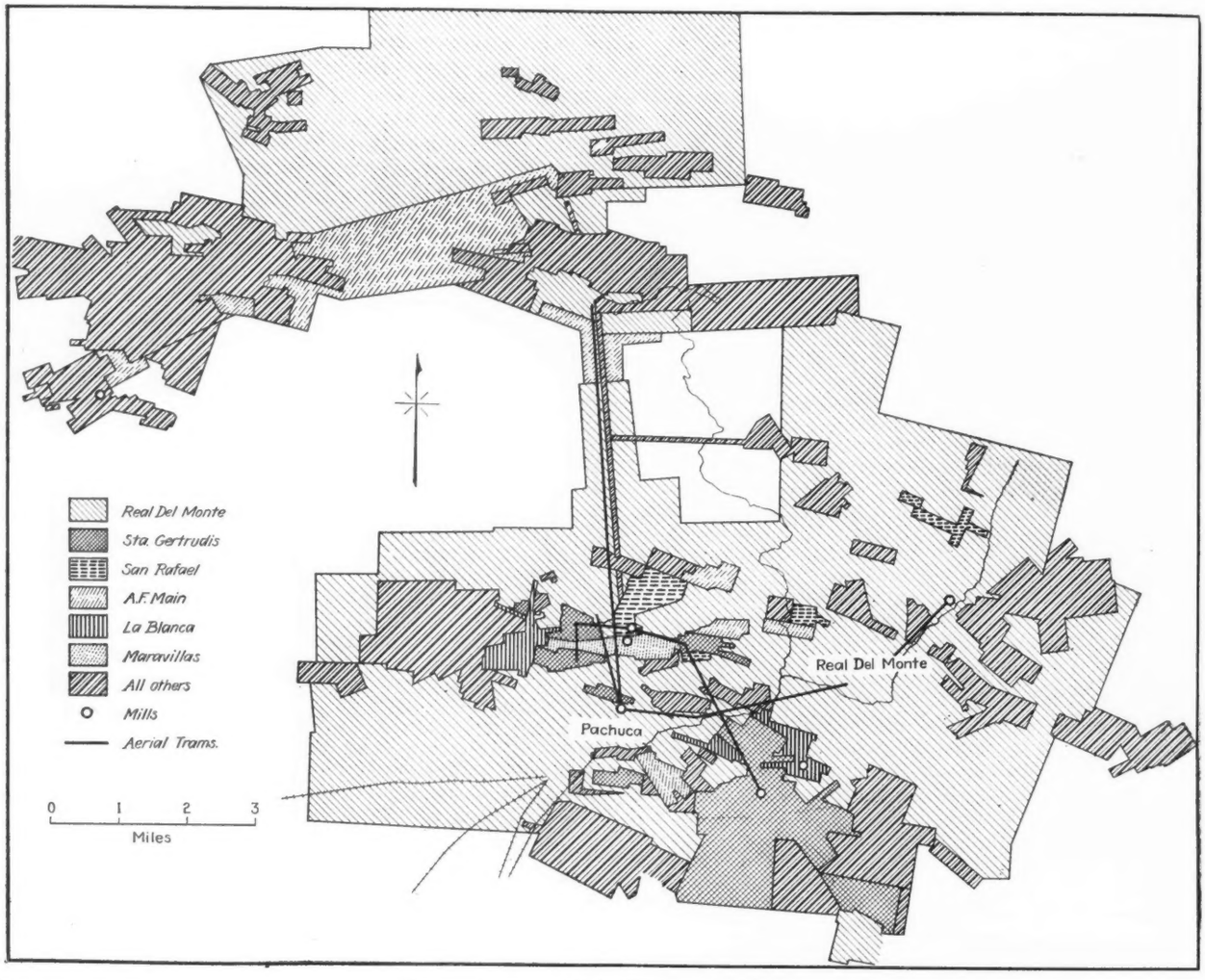
The great Vizcaina vein occupies a compound fault which in part forms a surface between the older andesite on the south and the younger andesite on the north. This fault has exposed the older andesite and its veins to erosion, with the result that the veins are comparatively shallow and the oreshoots come to the surface. The early discoveries in the district took place in this section. In the Vizcaina, the upper part of the vein is usually barren, or with low values, and the ore was found at depths of about 400 ft. To the north, under the cap of the younger andesite, the veins are found still deeper, at depths near 900 ft. The evidence of the erosion of upper and barren parts of the veins in some places, with the resultant exposure of ore on the surface, and the character of the ore in the deeper parts of the veins, indicate that secondary enrichment, although a factor in the orebodies, is probably of minor importance.

Much Lateral Development Under Way

It may be noted that the known veins fringe around the edges of the capping of the younger andesite, which occupies the center of the region. Under this capping considerable exploration work is being done in the form of long crosscuts at depth by the Real Del Monte and San Rafael companies.

Three productive veins have been opened in this area, on one of which the San Rafael is stoping an orebody 1,000 ft. long. Recently, the Real Del Monte denounced a large amount of this blind territory, and it is probable that future development will greatly extend the field under this capping. A crosscut south of El Chico toward Pachuca is projected, which will further prospect this region.

Another area of recent interest is the section south of the Santa Gertrudis vein where the surface wash of the valley has covered the andesite. During the last year the Santa Gertrudis cut a blind vein while driving for another, and the new find is proving of considerable importance. The vein is called the Dos Carlos and comes at an opportune time, as the main Santa Gertrudis vein is nearly exhausted. Interest in this southern extension has been greatly revived, and considerable development work is in progress. Consider-



Property map of the Pachuca district

ing the region as a whole, a large amount of promising territory remains to be developed.

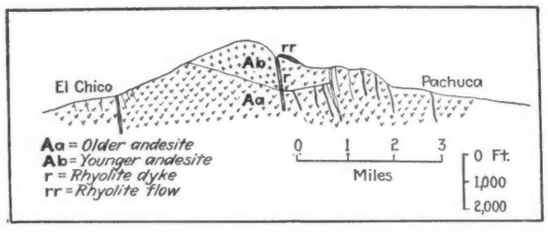
Real Del Monte Largest Operator

The region is dominated by a few large companies, of which the most important is the Real Del Monte company. After its early operations in the field, this company broadened its activities and made an intensive study of the region with a large staff of geologists, with the result that it blanketed with denouncements practically all the speculative extensions of the known veins. The extent of its holdings may be surmised from the fact that the company is paying taxes on more than sixty square miles of mineral ground, and is constantly increasing its properties.

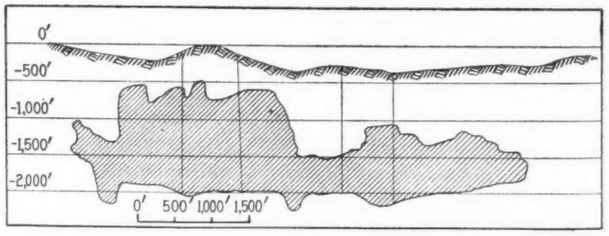
The Real Del Monte operates two cyanide mills, the largest of which, known as the Loreto mill, is in Pachuca and draws its ore by tramway and motor haulage from the Santa Ana and Camelia mines, on the Vizcaina, north of town, and from El Chico and Real Del Monte, by aërial tramway. This mill is treating about 2,200 tons per day; the Guerrero mill, situated in Real Del Monte, is handling 1,500 tons per day.

Santa Gertrudis Mills 1,500 Tons Daily

The Santa Gertrudis company is milling 1,500 tons a day, a part of which is coming from the El Bordo and Santa Tomas mines on the Vizcaina vein. Its operations are the second largest in the district. The San Rafael mine, after having been pronounced finished by the Mexican administration, has "come back" under American management. This company is developing north of the Vizcaina and is increasing its ore reserves as well as mining 450 tons per day of ore of good grade.



North-south geological section of the district



Typical section of the Vizcaina vein

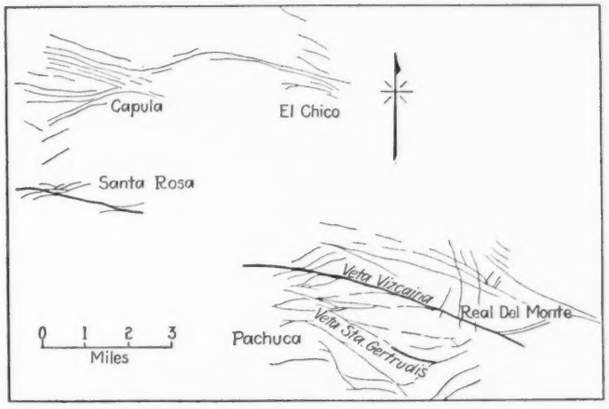
The hacienda of Purisma Grande is now treating a small tonnage of ore from the old Fresnillo mine, which is said to have operated steadily for 100 years.

The Blaisdell Coacotitlan Syndicate is still operating below Pachuca on the old patio tailings, but it is understood that only a small tonnage remains to be treated.

The personnel of the operating companies is as follows: Real Del Monte: D. S. Calland, general manager; M. H. Kuryla, assistant general manager; T. H. Phillips, general mine superintendent, and G. F. Embury, general mill superintendent; Santa Gertrudis: C. A. Lantz, general manager; F. H. Walsh, assistant general manager; N. F. Crawford, mill superintendent, and J. T. Barry, general mine superintendent. Frederick MacCoy is manager of the San Rafael and R. A. Conrads is general superintendent.

Old Fills Are Mined by Square-Setting

A variety of conditions are found in the mines of the district, and many different mining methods are used. There are generally two kinds of operation: the mining of fills and ribs in the previously worked veins, and the mining of ore in place. The old-time miner worked only the richest parts of the deposits,



The vein systems of Pachuca

leaving the lower-grade ore on the wall or in the fill. Later, with prodigal disregard for the future, the fills that would run were pulled, leaving a generally ruined condition. This necessitates careful mining in heavy ground, using square sets and close filling. Costs in this kind of mining are usually higher than in the mining of ore in place. Top slicing has been successfully used where conditions permitted.

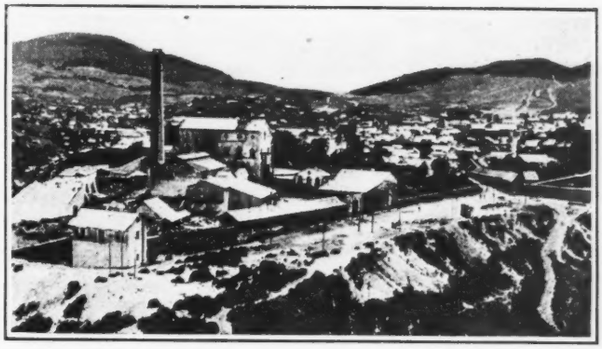
A flat-back filled stope system is generally used in the ore in place, the fill being obtained from development, old stopes, or glory holes on the surface. Rill and shrinkage systems have been used in some cases with success.

The limits of minable ore vary between 8 and 10 oz. of silver per metric ton (2,208 lb.), and the average grade milled in the district is about 14 oz., with a gold content of about 5 oz. for every 1,000 oz. of silver.

Mining costs vary between $2.50 and $4 per metric ton, according to conditions.

Mining Is Done by Contract System

All the unskilled and most of the skilled labor is done by natives. In the mine the breaking of ore is done by contract, the native miner being paid according to the number of cars he takes out of the stope. The



Difficultad mine of the Real Del Monte company

contractor buys his powder from the company and employs his own men. On an average, a native contractor will make from 40 to 60 pesos a week. The average wage in the mines is about 2.5 pesos, or $1.25 per day.

The average native is unreliable and requires close supervision. His habit of drinking huge amounts of *pulque* every day seems to deaden his sense to danger. Formerly the men were permitted to bring this native drink into the mines in hogskins, and in one place a one-inch pipe was used to facilitate the sending of the liquor into the mine; but the peon is now feeling the touch of prohibition and the miner is now limited to one liter and the amount that he can drink in the numerous *pulquerias* on the way to work—which is considerable. Supervision is mostly by Americans, the colony numbering nearly 300 Americans and English.

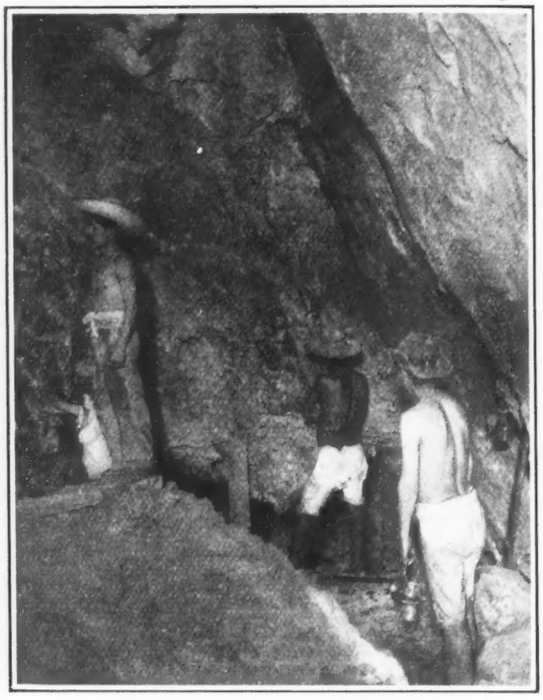
Standard Cyanide Practice Employed

The simple character of the ores was largely responsible for the success of the patio process, and cyanide had an easy application. The early flow sheets of the mills were similar: coarse crushing, followed by stamps, tables, and fine grinding in tube mills, followed by agitation in the well-known Pachuca or Brown tank.

The present equipment includes a combination of the old and the new. Stamps are used by the side of ball mills in practically all the mills for primary grinding. This is not because of the efficiency of the stamps, but because their inefficiency is not enough to warrant scrapping them.

Tables have been eliminated and all ore is cyanided. Formerly, high-grade ore and concentrate were shipped to the smelter. Fine grinding, 70 per cent to 75 per cent through 200 mesh, is the custom. Tube-mill practice varies somewhat in the various mills. The Real Del Monte, with plenty of tube-mill capacity and cheap

Santa Gertrudis mine plant, with its inclosing wall



Typical Mexican miners

This shows a stope on the 400-m. level of the Veta Nueva mine.

power, finds it more economical to use mine rock as the grinding material, while other mills have changed from rock to balls, to raise the capacity per mill.

All crushing is done in cyanide solution. A strength between 0.25 per cent and 0.35 per cent is commonly used. Merrill zinc-dust and Crowe vacuum systems are used in all the mills. The doré bullion varies in fineness between 950 and 980 parts silver and between 3.5 and 6.5 parts gold per 1,000. Melting of bullion is done in reverberatory furnaces. The Loreto mill is equipped with a modern electrolytic refinery, which in addition does a customs business for the other mills in the district. Milling costs vary between $1.25 and $2 per ton.

Pachuca probably will continue to produce for a long time. It is well equipped with working organizations and—more essential—it possesses large reserves of ore. But when it passes, as some time it must, it will mark the last of one of the greatest bonanzas in history.

Making Gold from Quicksilver

By Dr. James Rubinfeld
Correspondent, Charlottenburg, Germany

ALTHOUGH the recently announced discovery of Professor Adolf Miethe, director of the photochemical laboratory and photographical observatory of the Charlottenburg High School of Technics, in Germany, and of his assistant, Dr. Stammreich, who claim to have succeeded in getting gold from quicksilver by transforming the latter into purest gold,[1] is thus far of an exclusively scientific and by no means of a practical nature, it deserves mention in the *Mining Journal-Press*. The following are the historical facts:

Professor Miethe is sixty-two years old, and looks back upon a long series of scientific and practical successes, especially in the spheres of optics and photography, as he was a constructor of manifold telescopes, teleobjectives, a discoverer of magnesium light photography, astronomical photography, three-color photography, and spectral analysis. Several years ago he turned his attention to the dyeing or re-dyeing of transparent minerals or glass pastes with the use of ultra-violet rays or rays of long wave lengths. To this end he sucured from a mechanic a quicksilver lamp that yielded a particularly bright and continuous spectrum field which at first sight appeared most fit for such research work. Later, the professor and his assistant discovered that in the lamp there was a noticeable precipitate in the form of a tarnish. The effort to ascertain the nature of this substance led to the discovery of the presence of gold. The experiment was repeated many times, always with the same result. Then, with the idea that there is an atomic relation between mercury and gold, they constructed a special electric arc-lamp with two quicksilver electrodes, through which was passed a current of 400 to 2,000 watts for from 20 to 200 hours. In this way the quicksilver was vaporized within a vacuum.

The thin gold foils which had been deposited within the lamp were then analyzed by the method used by Professor Haber in determining the gold contents of ocean water, this being repeated over and over until there was no doubt whatever about the gold nature (octoedric crystallization, and so on) of the precipitate. In the opinion of the inventors there is here a metamorphosis, pure and simple, of the mercury atom, the atomic weight of which is 201 times that of hydrogen and comes nearest to that of gold, which is 197. They contend that the difference of weight that exists after the metamorphosis is to be ascribed to the vanishing of helium (weight 4) and hydrogen.

For the time being there is not the slightest prospect of the discovery having any practical or commercial application. For the sake of caution, Professor Miethe has protected his discovery by patent. In truth, it requires very large quantities of quicksilver to get only very light foils of gold, and the exuberant expectations of those who are dreaming of producing tons of gold in an artificial manner, and thus to dispose of the entire Reparations payments to the Allies, are not taken seriously here in expert circles, though only a little time ago as great an economist as Irving Fisher, in the United States, expressed this idea of artificial production of gold by German chemists for the purpose stated.

On the other hand, it is certain that any such important scientific discovery would bring, within a short time, not only to metallurgists but also chemists, a clearer conception of the character of the elements. As a matter of fact, radioactive substances are now known to transform themselves into other elements after a lapse of time. I am told that Professor Miethe himself characterises any manufacture of gold on a commercial basis (assuming it to be possible) as undesirable, for the very value of the precious metal lies in its rareness, and only by dint of this rareness does it form the communicative means between the nations and continents. The diamond, too, is only, it may pertinently be pointed out here, another form, and a rare one, of coal, and it would lose its charm by mass production.

[1]It was pointed out editorially in the *Mining Journal-Press* of May 16, 1924, p. 243, that an examination of certain quicksilvers produced in California, Nevada, and Texas has shown gold to an extent of 0.000524 oz. per 75 lb. flask, or 1 lb. of gold in 862.5 short tons of quicksilver. See also the editorial in this issue.—EDITOR.

Accuracy in Sampling Metallurgical Materials

By A. C. Halferdahl
Anyox, British Columbia

FAULTY SAMPLING is a frequent cause of error in metallurgical balance sheets, the accuracy of sampling being often an unknown quantity. These notes give a method of application of theory which is believed to be fundamental to all sampling procedure. The basis of the calculations is set forth first. The theory is due to Bowley, "Elements of Statistics," and Merriman, "Method of Least Squares."

If we consider two or more lots containing a metallic constituent designated by S, and select n_1, n_2, . . . parts from each, the respective deviations of S from strict proportionality are

$$d_1 = \sqrt{\frac{S_1(1-S_1)}{n_1}}, \quad d_2 = \frac{S_2(1-S_2)}{n_2} \qquad (1)$$

The total deviation of all of the selected parts or samples taken together is the square root of the sum of the squares of their separate deviations and

$$= \sqrt{S(1-S)\left(\frac{1}{n_1}+\frac{1}{n_2}+\ldots\right)} \qquad (2)$$

Let $(1-S) = U$.

If a lot of ore is assumed which is not uniform in its metal content from part to part, yet is of such a nature that each of the parts does contain some amount of the valuable mineral contents, then we may proceed in a sampling computation as follows:

Divide the lot into a number of parts and suppose that there are n_1 particles in one part, n_2 particles in the second part, ... n_r particles in the rth part; and in each of these parts let the number of particles having, say, a sulphide nature (if a sulphide ore is under consideration) be s_1n_1 for the first part, s_2n_2 for the second part ... s_rn_r for the rth part. Let N = total number of particles in all of the parts; that is,

$$N = n_1 + n_2 + \ldots + n_r$$

If S is the proportion of sulphides in the total number of parts, then

$$SN = s_1n_1 + s_2n_2 + \ldots s_rn_r \qquad (3)$$

In a sampling operation we desire to secure from each part a portion proportional to the weight of the part. If the parts do not vary in composition too widely, it may be assumed that the number of particles in the parts are proportional to the weights of the parts respectively. Suppose a portion p is cut from each part, then pn_1, pn_2, ... pn_r and $pN = n$ where n = total number of particles in all of the cuts. The deviation of s_1 in the first cut is

$$d_1 = \sqrt{\frac{s_1u_1}{pn_1}} \qquad (4)$$

where s_1 is the proportion of sulphide particles and u_1 is the proportion of non-sulphide particles.

From (3) $$S = \frac{s_1n_1}{N} + \frac{s_2n_2}{N} + \ldots \frac{s_rn_r}{N} \qquad (5)$$

and we may write $s_1 = S - d_1'$, $s_2 = S - d_2'$, . . . so that the sum of $d_1' + d_2' + = 0$
and the weighted deviation of

$$\frac{s_1n_1}{N} \text{ is } \frac{n_1}{N}\sqrt{\frac{s_1u_1}{pn_1}} \qquad (6)$$

The same course of reasoning may be applied to s_2. Then the total deviation for S in the sample becomes

$$d^2 = \left(\frac{n_1}{N}\right)^2\frac{s_1u_1}{pn_1} + \left(\frac{n_2}{N}\right)^2\frac{s_2u_2}{pn_2} + \ldots m =$$

$$\frac{1}{pN^2}(n_1s_1u_1 + n_2s_2u_2 + \ldots) \qquad (7)$$

and $pN^2d^2 = n_1s_1(1-s_1) + n_2s_2(1-s_2) + \ldots$

$$= \Sigma(ns) - \Sigma(ns^2) = NS - \Sigma n(S-d')^2$$

where Σ is the usual summation sign.

$$= NS - NS^2 - 2S\Sigma nd' - \Sigma nd'^2 = NSU - \Sigma nd'^2$$

since $\Sigma d' = 0$.
and

$$pN^2d^2 = NSU - Nd_r^2$$

where $$d_r^2 = \frac{1}{N}(n_1d_1' + n_2d_2' + \ldots)$$

then $$d^2 = \frac{SU}{pN} - d_r^2 = \frac{SU}{n} - d_r^2 \qquad (8)$$

d is the deviation for the final composite sample, S is the proportion of sulphide particles in the lot and d_r^2 is the weighted mean square of the deviations in the parts of the lot.

When the cuts are taken at random—that is, not in the parts by proportion—the deviation is d_o where $d_o = \frac{SU}{n}$. Therefore we may write

$$d^2 = d_o^2 - \frac{d_r^2}{n}$$

Evidently, small regularly spaced cuts give the most precise result provided the final weight of sample is the same in all cases.

A zinc concentrator received ore shipments during one month as follows:

From one mine every fifth car was cut out and sent through the sample mill. From another mine two cars in five were similarly sampled.

Mine M

Lot	Total Dry Pounds	Dry Pounds Sampled	Per Cent Zinc
1	534,105	105,300	12.5
2	542,619	100,500	10.0
3	571,725	109,400	9.5
4	564,795	122,200	11.1
5	531,210	97,100	9.3
6	528,710	113,400	8.9
7	552,585	109,300	7.7
8	583,358	115,800	9.9
9	669,438	120,900	13.1
Total.....	5,078,545	1,003,900	Average 10.17

Here $\sqrt{\frac{d^2}{n^2}} = \pm 0.542$ per cent.

Mine N

Lot	Total Dry Pounds	Dry Pounds Sampled	Per Cent Zinc
1	559,874	203,000	6.5
2	574,470	193,000	7.3
3	551,304	177,200	8.0
4	571,584	192,400	6.9
5	597,967	206,500	6.4
6	621,942	219,500	7.0
7	588,000	202,500	6.4
8	571,524	185,500	4.7
9	606,807	198,800	7.8
10	574,240	203,800	5.0
11	578,324	195,300	9.8
12	624,652	191,200	5.2
13	287,332	100,200	9.1
Total	7,308,020	2,560,600	Average 6.60

Similarly, the expected deviation is ± 0.416 per cent.

Other ores received which were all sampled were as follows:

Mine	Dry Pounds	Mine	Dry Pounds
O	187,544	R	666,438
P	754,575	S	400,000
Q	1,593,432		

Total for month is 16,360,018 lb.

Where all of the ore is put through the sample mill, calculations apply to the individual cuts by the sample cutters in the first and subsequent reductions, and are not questioned as to accuracy in this calculation.

The composite monthly sample assayed 10.07 per cent zinc. The accuracy of the sample may be computed by equations (2) and (7). The weighted deviation of the composite sample is

$$\sqrt{\frac{0.542^2 \times 5{,}079{,}000^2 + 0.416^2 \times 7{,}308{,}000^2}{16{,}360{,}000^2}}$$

$$= \pm 0.25 \text{ per cent}$$

or the composite sample is accurate to 10.07 ± 0.25 per cent zinc with reference to the total ore to the plant, which in itself would give an average or expected deviation in the metal balance of ±2.5 per cent. Larger and smaller deviations may occur and their frequency may be calculated.

Edward Keller, in Bureau of Mines Bulletin No. 122, "The Principles and Practice of Sampling Metallic Metallurgical Materials," gives several results of sampling copper and lead bullion by drilling. Reference may be made to Plate I of that bulletin, Case (a) being the data on 78 drilled samples from one slab of copper, and Case (b) on 78 samples from ten slabs of copper. On page 67 of the same bulletin, Case (c) may be taken as the results of 56 drill holes in a half templet, and Case (d) of 40 holes in a quarter templet. The calculations given in these four cases do not indicate that the templets are necessarily in error, but that the number of cuts or drill holes considered is relatively too small where the distribution of values is as erratic as appears in these cases. The same templets applied to give ten times the number of drill holes reported, would give deviations as follows:

Case	Deviation, Oz. Silver	Case	Deviation, Oz. Silver
(a)	0.239	(c)	0.357
(b)	0.263	(d)	0.425

Plate III opposite page 70 of the bulletin mentioned gives the results of drilled samples on quarter cakes according to a 112-, 40-, and 20-hole templet. Had these various templets been applied to the same quarter of the copper cake or bar, then the relative merits of a 112-, 40-, and 20-hole templet could be determined by use of equation (8).

Calculations to determine the number of cuts required in any kind of a sampling operation, to obtain a specified accuracy, can be made when a suitable number of individual cuts have been assayed.

The ideas here presented are not original with me.

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A Little Known Mineral Storehouse in Georgia

IN A REGION of little relief, minor elevations assume great importance as topographic features. Thus Graves Mountain, which in California would be a foothill, or in Mexico a "lomita," is, in the comparatively flat region west of Augusta, Georgia, a mountain, and the only one, until the outliers of the Blue Ridge are reached seventy miles to the north.

Graves Mountain is a timbered ridge, little less than a mile in length, and on its summit is a triangulation station of the U. S. Geological Survey. The elevation is 901 ft., while the surrounding country is about 500 ft. above sea level.

Graves Mountain, where a deposit of rutile has been found

The little mountain is a storehouse for rare minerals. Dana in his mineral textbook of fifty years ago, mentions the occurrence of a half dozen different minerals. The mountain mass is almost entirely sandstone that has been subjected to intense metamorphic and mineralizing influences. The lower slopes are covered up in the debris that has resulted from rock decay, but higher up the outcrops assume strange and fantastic forms, revealing to view everywhere, the minerals they contain so abundantly. The seams of the rock pitch almost vertically, and weathering has produced cliffs with steep faces, and monolithic obelisk-like shapes. The surfaces are pitted and sculptured into lace-like relief work, where the standstone has been dissolved and the more resistant minerals have remained.

Some of the rock faces have a velvety covering of the mineral pyrophyllite in its radiated form that glistens in the sunlight. The deep blue of lazulite imbedded in the white sandstone is seen frequently and still more common are the crusts of interlacing blue and white plates of cyanite. There are veins and veinlets of quartz and the iron minerals, hematite and menaccanite occur in such abundance as to suggest commercial deposits, though menaccanite is not now a desirable iron ore, on account of the titanium it contains. The most interesting of the mineral species is the oxide of titanium known as rutile. It is found in a matrix of iron and cyanite, which occurs in great abundance near the summit of the mountain.

Some years ago, an attempt to mine this mineral was given up on account of the difficulty of freeing the crystals from the matrix. A number of open cuts have been made, and from the waste that was shot out of these cuts one can still obtain an occasional good crystal of this lustrous, adamantine mineral. The mining was done to obtain cabinet specimens, and some $20,000 worth of crystals are reported to have been won. Prof. Charles U. Shepard in 1869 mentioned the occurrence of gold and pyrite at the southern end of the mountain and stated that it had been worked for gold. The same observer remarks that the rock resembles itacolumite or flexible sandstone.

Prospecting by Radio

Development and Possibilities of Electrical Investigations by This Method

By Wilbur C. Riley
Caliente, Calif.

ELECTRICAL PROSPECTING is not, contrary to what seems to be the popular belief, a new method. The various attempts to evolve a reliable means of locating orebodies electrically cover a period of more than thirty years. In 1890 attempts were made to locate sulphides through the medium of conductivity, using a telegraphic receiver connected in series with a battery and a wire brush. Contact was made in the earth and the brush was moved over the surface. When touching sulphides the brush would complete the circuit, causing a click in the receiver. As it could be used only on mineralized surfaces already exposed, the method was of little or no value.

For several years further attempts were made, using the wheatstone bridge, an instrument for measuring resistance. Here again conductivity was the deciding factor, but indirectly, the conductivity between two points on the earth's surface being calculated by first measuring the resistance. This method was also impracticable, owing chiefly to the high resistance at the points of contact on the surface. The resistance measurements were not truly indicative of the conductivity.

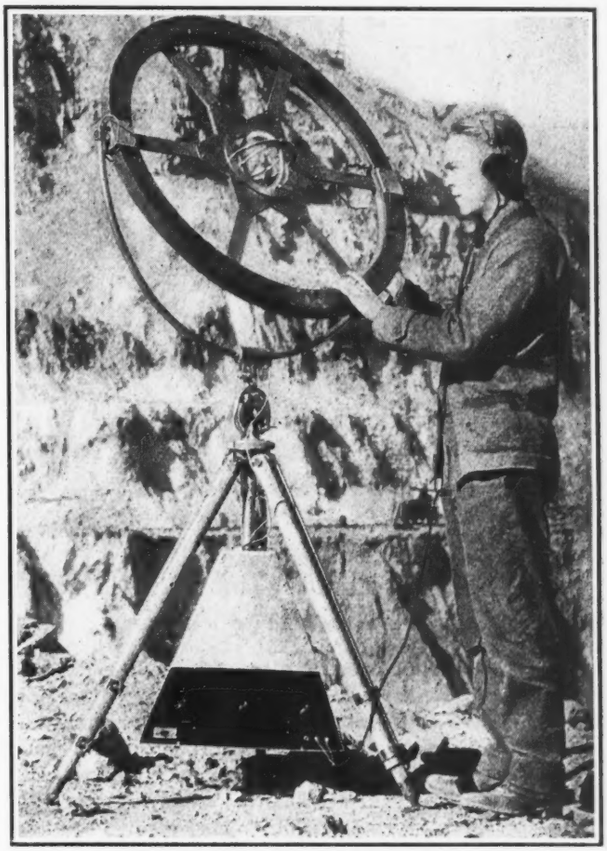
Another method which has been given considerable publicity employs the measuring or plotting of equal potential lines. Direct current or low-frequency alternating current is allowed to flow between points, and the lines of equal potential across the field are plotted by means of a galvanometer of a telephone. The presence of an orebody causes these lines to warp or distort. Although this method has been successful in a degree, water strata, uneven moisture areas, and other substances in the soil give indications which could be misconstrued as indicating the presence of an orebody. On the other hand, failure of this method to indicate ore would not necessarily indicate barren ground. The oxidized condition existing above sulphide orebodies forms an almost perfect insulator, and an orebody thus insulated may cause indications similar to those caused by granite or other insulating materials. The low resistance of acid dikes to direct currents or low-frequency alternating currents has been a source of annoyance in trying to determine the presence of ore by this method and on one or two occasions costly.

Considerable time has been spent upon another method in which an intense magnetic field is created without the use of any electrical contacts on ore or earth. The presence of an electrical conductor of a very low resistance, such as an orebody, causes a distortion of this magnetic field which can be determined by a receiving device operated in close promixity. This method obviates all errors caused by moisture, acid-bearing rock, and like factors, and is limited only by the short distance in which the intensity of the magnetic field is effective.

Probably most experimenters have attempted the use of the induction balance in seeking a method for locating ore. This method would appear ideal, because of the fact that it could detect the presence of gold as easily as sulphides or the other more massive minerals. The difficulty of attaining a practicable depth has prevented the use of this method.

A process for locating sulphide orebodies by radio, a description of which follows, was developed by Daniel G. Chilson at the Bureau of Mines, University of Arizona, some time ago and, like some other processes, has since been used commercially.

Briefly, the fundamental principle upon which the Chilson process operates is as follows: Contact is made upon sulphide ore having electrical continuity, with electrical energy of the proper frequency impressed upon same in such manner that all connecting ores will act in unison with the transmitter and as a part of the transmitter. A receiver, then, operated in proximity to ores thus affected, will indicate their location, through the medium of the magnetic field caused by the ores acting as part of the transmitter. It has proved possible with this method to locate sulphide orebodies, under favorable conditions, to depths of 2,000 ft. or more.

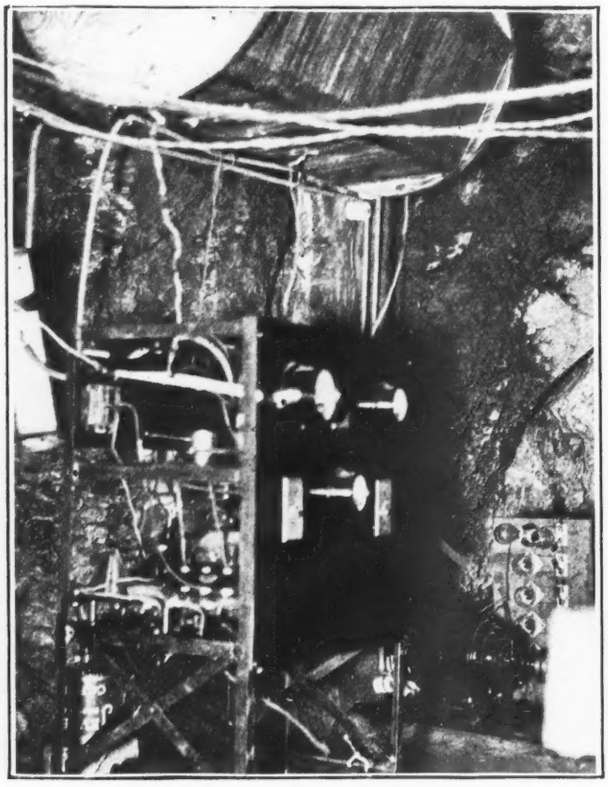


View of the field receiver, showing the operator taking a dip reading

The idea of electrically locating orebodies was first conceived by Mr. Chilson in 1904, in Goldfield, Nev. The discovery of large orebodies at depth, where frequently the surface geology did not indicate the presence of ore, furnished the incentive for his early experiments. These early experiments were made to determine the conductivity of various elements, earth, water, and other substances, and it was found that

sulphides furnished the best conductors. In 1909 Mr. Chilson turned to radio, experimenting with short waves, using the method now in use for directional telegraphic communication. In 1911 experiments were made with the induction balance. During the following two years considerable time was spent in determining the audibility of signals from radio stations, through readings taken in so-called "dead spots" in Alaska.

Comparative conductivity tests on sulphides and soils



The transmitter installed underground

proved the electrical continuity of sulphide orebodies, contrary to the general contention of geologists that orebodies at depth are not connected. By introducing different electrical frequencies in sulphide orebodies it was found that by using a critical frequency, sulphide orebodies could be followed, regardless of other conductors, earth, water, or other material. The results obtained at that time proved accurate and established the practicability of the process. During the following five years tests were made in many camps in California and Arizona, with good results. From 1920 to 1922 further experiments were carried on for the University of Arizona, and refinements and improvements were made which brought the process to its present state of perfection.

The frequency of the electrical impulse is the deciding factor in making this possible. Where the impulses vary from 300,000,000 impulses per second to 100,000 impulses per second the waves created are very difficult to classify, because they are affected in the same manner as light, being reflected from metals, waters, and hills. Impulses varying from 100,000 to 40,000 per second are affected only slightly, and while having the advantage of following metal conductors do not pass through earth and water as readily as lower frequencies. These two groups are known as radio frequencies. The range between 40,000 and 20,000, known as audio, or audible, have similar advantages and disadvantages. Between 20,000 and 0—or, in other words, nearing a continuous flow of current—the disadvantage of the current flow taking place through wet materials, rock, and soil makes the use of this group of frequencies impracticable. The range of audio frequencies between 40,000 and 20,000 is the one generally used in this work. However, a higher frequency, within the radio band, can be used to good advantage as a means to check the results obtained with the lower frequencies.

The quality that an electric current possesses of oscillating within definite limits determined by the frequency of the current and the conductivity of the body submerged within any substance makes possible the location of any exact area of predetermined conductivity value. This action is similar to the action which takes place in a radio antenna which is highly insulated so that high frequency oscillatory currents may be used with minimum leakage. Inferior insulation might be used with lower frequencies and with some loss in efficiency. This could be likened unto the underground ore contact of the transmitter used in this work.

The apparatus used in this work consists of two units, a transmitter designed to radiate the proper current at the desired frequency and a receiver with which to record the audibility of the signal. The transmitter is generally installed underground and contact made upon sulphides. The receiver is a radio receiver of special design employing several stages of amplification. The receiver cabinet is suspended from a tripod and the receiving coil is secured to the tripod in a swivel frame, so that it may either be swung in an arc or dipped horizontally. In taking readings the receiver is set up and the coil, in a vertical position, is swung in an arc until maximum signal audibility is reached. This gives the strike of the ore. Without changing the strike of the coil it is dipped horizontally until maximum audibility is again reached. This gives the dip angle. After several set-ups taken in line these dip angles are projected, and the apex of the resultant triangle is the center of the magnetic field caused by the orebody acting as part of the transmitter. When directly over an orebody, the dip angle is, of course, zero.

It is claimed that it is possible to cover as large an area as thirty or forty square miles without moving the transmitter. This depends, of course, upon the character of the particular field being surveyed. In mineralized ground it is possible to make as many as eighty or more set-ups a day.

That the process may possibly be instrumental in opening many new districts is indicated by some interesting results obtained recently in an Arizona copper district. Considerable work had been done in territory skirting the copper district, in an area that was generally conceded to be barren. At several locations the readings indicated ore. Several months later Mr. Chilson visited these locations for the first time, and in four of the places found sulphides upon the surface. It is interesting to note that the operator who took the readings had no knowledge of mining or geology.

The inventor claims that the process not only provides a quick and accurate method of locating sulphide orebodies, but that it obviates the possible expenditure of large sums in the development of barren ground. For the geologist, he claims, it provides an accurate check. In short, electrical prospecting is destined to become as necessary an adjunct of the mining industry as the engineer or the geologist.

Commercial Possibilities of the Magnetite Slates of the Cuyuna Range*

Fine Grinding Will Be Necessary—Calculation of Costs Awaits More Extensive Drilling

By George A. Thiel
Department of Geology and Mineralogy, University of Minnesota

SINCE the Mesabi Iron Co., organized by the D. C. Jackling interests and Hayden Stone & Co., has had some success in concentrating the magnetite rock of the eastern end of the Mesabi range, new interest has been aroused in the magnetite deposits of the Cuyuna range. It is the purpose of this article to outline briefly the occurrence of the magnetite-bearing formations, their relations to the intrusive igneous rocks of the region, and the bearing of the microstructure of the ore on the possibility of magnetic concentration.

The physical structure of the ore is one of the first things to be considered in any concentrating problem; therefore, a study of the structure and textural relationships of the ore and gangue minerals is a prerequisite to any successful attempt at concentration. Also, since the method of liberating the particles of magnetite consists in crushing or bringing the ore to such a size that the individual magnetite grains are liberated, the size as well as the textural relations of the mineral grains must be taken into account.

The size of the grains determines the fineness of the grinding, and this in turn establishes the method of concentration that can be most satisfactorily employed. The greater the range in size of ore particles to be separated by any magnetic process, the poorer will be the metallurgical results[1]. This is due to the difference in the force by which particles of different size are attracted by the magnet, and to what may be called the mutual attraction between particles when they become magnetized.

When finely crushed ore containing magnetite and silica is brought into a magnetic field, two reactions are evident: first, the magnetite particles mutually attract one another, and entrain considerable silica; and, second, each magnetite particle, together with the entrained silica particles, tends to move toward the controlling magnetic pole. When the material is finely ground, mutual attraction causes the entire mass to move as a single particle. In the separation of finely ground ore this principle is employed: The whole mass of material, including magnetite and gangue, is held by a controlling magnet, while it is agitated sufficiently to allow the non-magnetic minerals to become free and be carried out in the tailing[2].

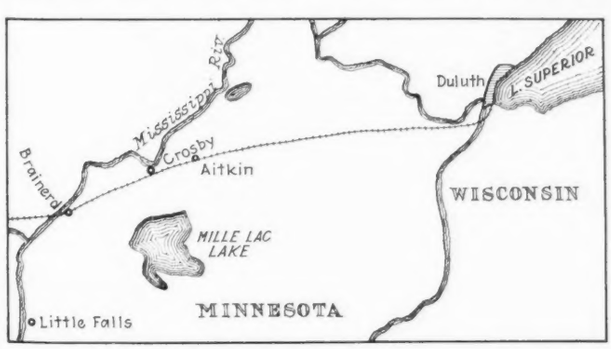
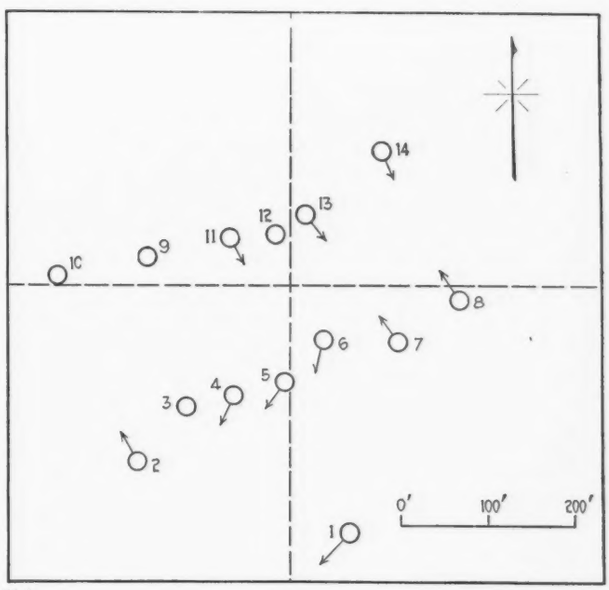


Fig. 1—Sketch map showing the location of the Cuyuna range magnetite slates



Hole No.	Type of Ore	Depth of Ore, Feet	Per Cent Fe
1	Magnetite-hematite-quartz slate	305–525	30
2	Lean banded magnetite	350–400	18
3	Lean banded magnetite	342–403	24
4	Lean banded magnetite	315–412	26
5	Magnetite-hematite-quartz slate	289–340	37
6	Banded magnetite slate	335–644	32
7	Banded magnetite slate	95–250	24
8	Lean magnetite slate	180–260	20
9	Lean magnetite slate	160–300	20
10	Lean magnetite slate	175–240	22
11	Banded magnetite slate	342–403	26
12	Banded magnetite-hematite-quartz slate	160–420	40
13	Banded magnetite-hematite-quartz slate	240–256	28
14	Banded magnetite-hematite-quartz slate	455–515	22

Fig. 2—Sketch of an exploration sheet

The system of drilling used in exploratory work on the Cuyuna range magnetites is shown.

Geology of the Ore

The magnetite slates of the Cuyuna range represent a phase of the Deerwood[3] iron formation which is the productive horizon of both the iron and the manganese ore on that range. Most of the magnetite is found on the so-called South range, which is situated to the south of the Northern Pacific Railroad, from Brainerd to Aitkin. (See Fig. 1). Owing to the thick mantle of glacial drift, there are no surface outcrops of the

*Published by permission of the Director of the Minnesota Geological Survey.

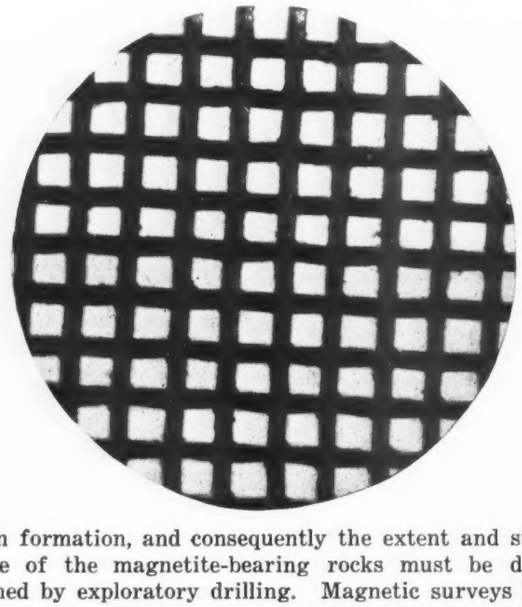
[1]Davis, E. W. "Magnetic Concentration of Iron Ore." Minnesota State Mining Experiment Station, Bull. No. 9.

[2]Davis, E. W. *Op. cit.*

[3]Johnson, A. W. and Harder, E. C. "The Geology of East Central Minnesota." Minnesota Geological Survey, Bull. 15, 1918.

Fig. 3—Photomicrograph of a 20-mesh screen magnified 65 diameters

Compare the openings in the screen with the size of the magnetite grains in Figs. 4 and 5, which have the same magnification.



iron formation, and consequently the extent and structure of the magnetite-bearing rocks must be determined by exploratory drilling. Magnetic surveys have been used extensively in outlining the strike of the formation, but locally magnetic lines are not a safe criterion for the presence of magnetite, as extensive deposits of magnetic pyrrhotite occur in the carbonaceous phases of the formation. This is especially true in the region of Long Lake. I have described[4] the structures and extent of these pyrrhotite deposits as an aid to exploratory work in that region.

The most promising bodies of magnetite rock that have been drilled are found in a rather narrow zone extending from Sec. 20 T. 46 N., R. 28 W., to Sec. 32 T. 44 N., R. 31 W., Several isolated masses to the north and west of the general strike of this zone are found in Sec. 32 T. 133 N., R. 32 W., Sec. 5 T. 132 N., R. 32 W.; and in Sec. 26 T. 135 N., R. 38 W. These may owe their origin to the metamorphic effect of large gabbro masses that have been intruded into the slates of these regions. The approximate size and strike of the magnetic lenses is illustrated in Fig. 2. No complete detailed sections of the magnetite-bearing horizon has been established, because of the lack of diamond-drill cores. Much of the drilling has been done by means of churn drills. The deposit shown in Fig. 2 is covered with 120 ft. of glacial drift, and dips to the south at an angle of nearly 70 deg. The bed containing magnetite is approximately 140 ft. thick and can be followed along the strike for a distance of nearly 800 ft. It shows a wide variation in its iron content throughout that distance. Similar deposits, some larger and some smaller, most of them near igneous intrusives, have been drilled in Secs. 21 and 30 in T. 46 N., R. 28 W.; Secs. 20, 25, 28, 35, and 36 in T. 46 N., R. 29 W.; Secs. 2, 3, 7, 9 and 18 in T. 45 N., R. 29 W.; Secs. 20, 21, 22, 27, 32, and 33 in T. 45 N., R. 30 W., and in Secs. 22, 32 in T. 44 N., R. 31 W., and Secs. 22, 1, 12, 21 in T. 43 N., R. 32 W.

During the last two years I have examined hundreds of drill cores from the locations listed above, in an attempt to determine the extent of the magnetic lenses, their continuity along the strike, and the variations

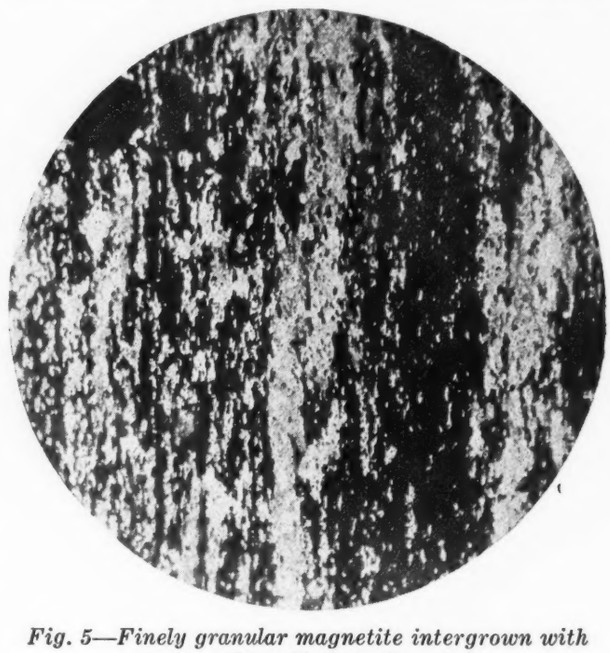


Fig. 5—Finely granular magnetite intergrown with quartz. Magnified 65 diameters

Note the intimate mixture of fine grains of iron and quartz as compared with the size of the openings in Fig. 3. Magnetite black.

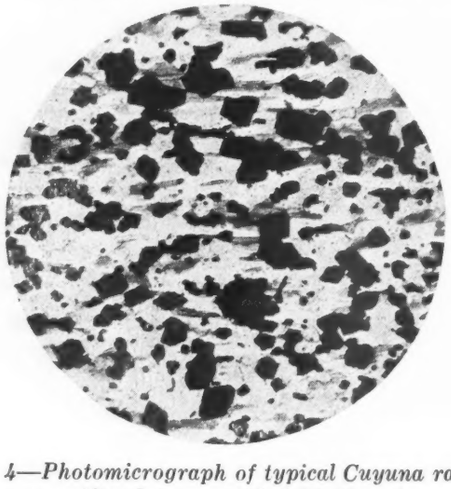


Fig. 4—Photomicrograph of typical Cuyuna range magnetite slate magnified 65 diameters

Magnetite grains black. Compare the size of grains with the openings in screen, Fig. 3.

in the magnetite contact across the bedding of the formation.

The rocks were found to consist of two phases: first, a siliceous-hematite-magnetite slate; and, second, amphibole-carbonate-magnetite slates. Harder and Johnson have given a preliminary report on the general features of these formations,[5] and I have constructed a generalized geologic section of the entire range.[6] Both of the phases of the formation mentioned above were once sedimentary iron-bearing strata which have undergone intensive metamorphic alteration and recrystallization. They are now banded or laminated rocks, many of which are very dark-colored with a tinge of green. They consist mainly of amphibole and magnetite associated with chert or quartz. As is usual

[4]Thiel, George A.: "Iron Sulphides in Magnetic Belts Near the Cuyuna Range. *Econ. Geol.*, Vol. 19, 1924.

[5]Harder, E. C., and Johnson, A. W.: Minnesota Geological Survey, Bull. No. 15.

[6]See Thiel, G. A.: *Econ. Geol.*, Vol. 19. p. 107.

with most of the slates of the Lake Superior region, the magnetite slates rarely, if ever, show slaty cleavage and might perhaps be more properly termed as a magnetite-argillite. The banding in the rock is due to the segregation of the different minerals into layers and also to a difference in the coarseness of the crystallization. Thus layers of fairly pure magnetite alternate with layers of amphibole and a green micaceous mineral, perhaps stilpnomelene or diabantite, or of quartz and amphibole. Some bands are very fine-grained, especially those consisting mainly of magnetite. The segregation of minerals in the amphibole-magnetite rocks and the siliceous-hematite-magnetite rocks is never perfect. Small amounts of magnetite are usually disseminated through quartz and amphibole layers, while quartz and amphibole occur intermixed with magnetite along the borders of magnetite bands.

The magnetite slates of the Cuyuna district differ from the typical amphibole-magnetite rocks of the other Lake Superior districts, such as the Mesabi, the Gogebic, and the Marquette. The ore of the Mesabi Iron Co. at Babbitt is much coarser grained and very irregularly banded,[5] whereas the rocks in the Cuyuna range are fine-grained, and more perfectly laminated. In general, they also contain less quartz and more ferromagnesian minerals. The Mesabi magnetite ore contains coarse-grained quartz and amphibole between the irregular layers of fine-grained magnetite. In the Cuyuna district, the coarse quartzose and chert phases are more characteristic of the horizons of the slates that are low in magnetite.

With a decrease of magnetite and iron carbonate the slates grade into green amphibole slates that are dark green in color and show a well-developed slaty cleavage at varying angles to the lamination. They consist mainly of a network of finely crystalline amphibole, but considerable iron carbonate and, locally, magnetite is present as well.

Texture Makes Fine Grinding Imperative

Although the rock shows distinct layers of magnetite, amphibole, and quartz, still the bands of purest magnetite contain sufficient silica to make them non-merchantable. For this reason, fine grinding is necessary to liberate the silica grains. Figs. 3, 4, and 5 show the relation between the size of the magnetite grains and the openings in a 200-mesh screen, both magnified 65 diameters. Table I gives the mesh and the corresponding size of the openings of a series of average weight screens in inches.[6]

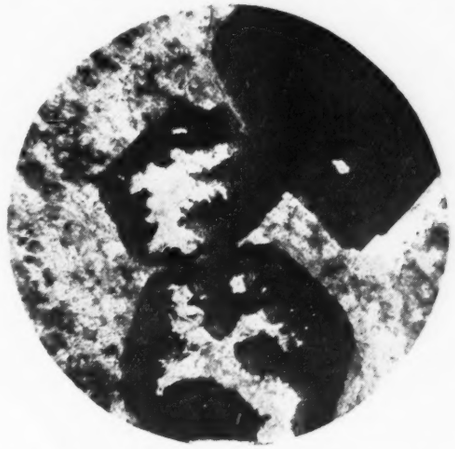


Fig. 6—Large crystals of magnetite, altered to martite, in the slates near intrusive dikes of basic igneous rocks. Magnification same as in Figs. 4 and 5

Fig. 7—Crystals of magnetite altering to hematite around the margins. Magnified 175 diameters

As such alteration increases, the possibility of concentrating the ore magnetically decreases. The alteration is most pronounced near the intrusive igneous rocks.

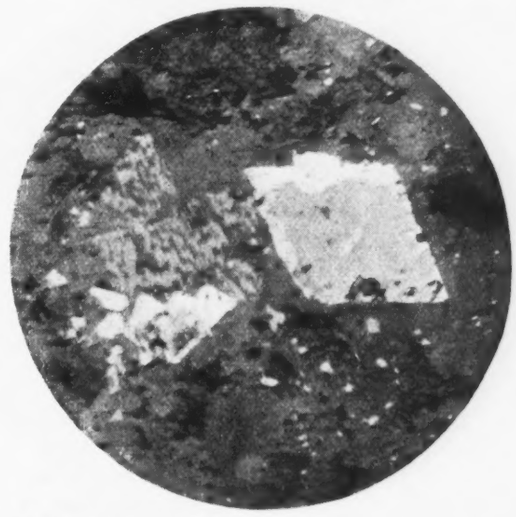


Table I

Mesh or Openings per Linear Inch	Size of Openings in Inches	Mesh or Openings per Linear Inch	Size of Openings in Inches
10	.065	100	.0058
20	.0328	150	.0041
35	.0164	200	.0029
65	.0082		

By comparing Figs. 3 and 4, it is at once evident that the ore must be ground between 150 to 200 mesh, as many of the magnetite grains are even smaller than the openings in the 200-mesh screen. Unless it is ground fine, too much silica will adhere to the magnetite and be carried into the concentrates.

Fig. 5 shows the texture of the average magnetite slate. It represents one of the dark magnetic bands of the laminated phases of the ore. Some bands contain slightly coarser grains of magnetite (Fig. 3), and less quartz, and others contain extremely fine magnetite particles disseminated through a greater amount of quartz. The magnetite occurs in two different forms. Fig. 3 shows a phase in which most of the grains are subhedral or euhedral in outline, and in Fig. 4 the minute grains are so closely spaced that distinct crystal outlines are not developed. More coarsely crystalline ores (see Fig. 6) occur near some of the igneous dikes and sills, but most of it has altered to martite (hematite pseudomorphic after magnetite).

The occurrence of hematite as a later alteration product of magnetite is not confined to the coarsely crystalline ore. Most of the magnetite slates show considerable alteration. Fig. 7 illustrates the rims of hematite around a magnetite grain. Wherever hematite is abundant, the possibilities for commercial concentration of magnetite are decreased, for with the alteration from magnetite to hematite, the magnetic properties of the ore are lost, and a high percentage of the iron would be carried into the tailings. The analyses of the cores taken from the orebody illus-

[5] Grout, F. F., and Broderick, T.: Minnesota Geological Survey, Bull. 17. Schwartz, G. M.: *E. & M. J.-P.*, Vol. 116, 1923.

[6] Davis, E. W.: *Op. cit.*

trated in Fig. 2 show how the alteration has advanced. The cores with the highest iron content are composed of hematite slate. In this orebody, which lies near a massive gabbro, alteration has proceeded to such a stage that the practicability of magnetic concentration is doubtful.

The "Blue Hematite" of the Mesabi Range

A similar alteration has produced the high-grade "blue hematite ore" of the Mesabi range, the paragenesis of which has been described in detail by Dr. Gruner,[9] but on that range the silica had been leached more completely from the iron formation. The magnetite ore in the east end of the Mesabi range also contains many pseudomorphs of hematite,[10] but the percentage of Fe_2O_3 is much less than in the magnetic slates of the Cuyuna.

Table II gives the results of tests on a sample of typical Cuyuna Range magnetite rock, tested at the Minnesota School of Mines Experiment Station. The sample tested was finely crystalline and contained a considerable amount of specular hematite.

Table II—Magnetic Log-Washer and Table Test on Cuyuna Range Magnetite[11]

Products—150 Mesh	Per Cent Weight	Per Cent Total Iron
Feed	100.00	34.41
Magnetic log concentrate	32.56	68.19
Magnetic log tailing	67.44	18.03
Table concentrate	8.78	67.07
Total tailing	58.66	11.19
Total concentrate	41.34	67.36

Complete Analysis of Products

Assay	Crude Ore	Concentrate	Tailing
Ferrous iron	7.69	16.41	1.54
Ferric iron	26.72	50.95	9.65
Total iron	34.41	67.36	11.19
Silica	42.20	5.27	68.21
Phosphorus	0.114	0.021	0.180
Manganese	0.11	0.20	0.06
Alumina	3.89	0.50	6.27
Lime	0.63	Trace	1.07
Magnesia	1.67	0.14	2.74
Titanic acid	0.19	0.16	0.20
Ignition loss	0.82	0.07	1.14

The hematite could not be recovered by magnetic processes, and it was necessary to pass the tailings over concentrating tables to recover the non-magnetic iron oxides. The table shows the possibility of making a high-grade Bessemer product from the magnetite slate. The process, however, is an expensive one, and only with a big reserve of easily available ore could the rock be handled commercially.

Other Economic Considerations

Because of the thick surface of glacial drift, an average of near 100 ft., open pit quarrying would necessitate extensive stripping operations. In many occurrences the belts of magnetite slate are so narrow, because of the steep dip of the beds, that an open quarry with such dimensions would be difficult to operate. The distribution of magnetite is not uniform over any large area. Therefore, drill holes must be closely spaced before a reliable estimation of tonnage can be established. Not until more extensive drilling reveals the quality and quantity of the ore, can calculations of costs be determined. Before this has been accomplished, further expenditures for concentrating plants are not justified.

[9]Gruner, J. W.: "The Paragenesis of the Martite Ores of the Mesabi Range." *Econ. Geol.*, Vol. 17, 1921.
[10]Grout & Broderick: *Op. cit.* Schwartz, G. M.: *Op. cit.*
[11]Davis, E. W.: *Op. cit.*

New Process of Making Magnesium

Lightness of the Metal and Its Value as an Alloy Suggest New and Important Applications

Until recently, says a writer in *Chemical and Metallurgical Engineering*, magnesium was for the most part produced by the electrolysis of fused magnesium chloride, to which was added fused sodium chloride and potassium chloride to maintain a low melting point of the bath. Production on a large scale was first accomplished in Germany, the raw material being obtained from the Stassfurt salt deposits. The method was not only conducive to the production of a metal containing harmful impurities, but it was also fraught with serious difficulties. If the molten magnesium came in contact with the evolved chlorine, recombination took place and the accidental presence of magnesium oxide in the bath seriously interfered with the electrolysis. These and other difficulties were largely overcome by greatly complicating the process, but two great disadvantages remained: The process was discontinuous and expensive.

A new process has been developed by the American Magnesium Corporation for electrolyzing magnesium oxide. In this process the oxide is added to a bath of fused fluorides, principally magnesium fluoride, in a specially developed electric furnace. The lining of the furnace is composed of unfused electrolyte, which, being next to the cool walls, remains in the solid state. Magnesium oxide is continuously added to the bath, while magnesium metal is removed at one electrode and carbon monoxide (the carbon coming from the electrode) is evolved at the other.

Magnesium oxide is only slightly soluble in the fluoride bath—in which respect it differs considerably from aluminum oxide—the solubility being only about 0.1 per cent. Strictly speaking, therefore, the process is probably not a direct electrolysis of the oxide. It has been suggested that the mechanism of the reaction is as follows:

$$MgF_2 = Mg + F_2$$
$$MgO + F_2 = MgF_2 + O$$
$$C + O = CO$$

Magnesium fluoride is electrolyzed, producing magnesium and fluorine. The latter immediately combines with the magnesium in solution to produce more magnesium fluoride. As this dissolved oxide is broken up, more dissolves, keeping the solution saturated. The oxygen of the oxide, which is replaced by fluorine, combines with the carbon of the electrode to produce carbon monoxide. It is evident that in metal produced by this process the presence of sodium or chlorides is practically impossible and that the detrimental effects of these impurities are avoided.

Magnesium is a metal that is extremely light and one that with a little alloying material is strong and tough. It resists the action of alkalis and is immune to the action of hydrofluoric acid. It is also readily worked. These and a few other good qualities of lesser importance in a metal that is being produced in increasing quantities at decreasing cost provide numerous possibilities of use that are not yet apparent. It is left for the future user to discover that certain combinations of these properties may make magnesium or one of its alloys of increasing utility in the industries and the arts.

Copper Mines That Fly and Eat Bananas

They Like Highly Colored Literature, But Can Be Calmed and Quieted By a Sweet Song

By George L. Walker

SOME REMARKABLE STORIES have been told about copper mines, but how many have heard of copper mines that fly, roost on high trees, utter hoarse, cat-like cries, and eat bananas? Such copper-bearing formations undoubtedly exist, and the source of the copper is puzzling.

The reader need not take my word for it. His Webster's International Dictionary will tell him that the touraco is an African bird, the feathers of which yield a peculiar pigment, turacin. If he will then turn to turacin, he will find that it is an amorphous, reddish pigment containing copper, and that it is obtained from certain feathers of several species of touraco. He will be interested to learn, also, that the touraco are of the family *musophagidæ*, somewhat allied to the cuckoos. That the bird really is "some cuckoo" will be revealed by further investigation.

Joachim John Monteiro, an associate of the Royal School of Mines, spent several years in western Africa in the early 1860's In his interesting book "Angola and the River Congo," published by Macmillan in 1875, it will be found that a "Professor Church," in a paper in the *Phil. Trans.* for 1869, had told of discovering copper in the red wing-feathers of the touraco, then called plantain eaters.

Mr. Monteiro obtained a large bunch of the feathers, and his brother-in-law, Henry Bassett, F.C.S., verified Professor Church's results conclusively, finding 7.6 per cent and 8 per cent of metallic copper. The coloring matter in the feathers was dissolved readily by nitric acid, but was insoluble in benzol, sulphide carbon, or tetrachloride. The copper could be seen unmistakably when a feather was placed in the flame of a Bunsen burner.

Mr. Monteiro became greatly interested in these birds. He seemed to doubt that the copper possibly could be obtained from their food—which, elsewhere it is found, consists of bananas, tamarinds, pawpaw, and other fruits, varied by insects, worms, mollusks and small birds—and he advanced the theory that they picked up, with sand and gravel, the attractive particles of malachite then quite universally scattered over Angola. However, two birds which he secured and kept in confinement for five or six years in England moulted regularly and reproduced feathers of the same color and brightness, though they could not have obtained copper meanwhile other than from the ripe fruits, cooked vegetables, and grains with which they were fed.

If it is well that a hunter should know the habits of the game he would shoot, is it not equally desirable that engineers and promoters should know the habits of mines they would develop or finance? The touraco, or plantain eaters, being the only animate copper mines known, their habits certainly should be a matter of scientific interest. Although they prefer bananas, they readily adapt themselves to any kind of *soft* food. In captivity they soon become delightfully tame and gentle, taking a keen notice of their surroundings, presumably being on the watch for wildcats to appear in the offing. When bright colors were brought before their cage they would raise their beautiful wings in astonishment, utter a loud cry and examine the dresses, ribbons, and so on, with much show of curiosity. They were fond of having picture books shown them, especially those with vividly colored pictures. Unfortunately, Mr. Monteiro neglected to state what their reaction was when shown a lurid copper-mining prospectus.

Mr. Monteiro gives us one bit of information which should prove of much usefulness to engineers in the field. "At night it roosted," he says, "in a little, flat basket, in which it would not readily nestle until one of my sisters sang to it for a few minutes, when it would utter a satisfied kind of low, rumbling noise, and at once squat down quietly to sleep."

As long ago as 1818, Jules Verreaux observed that one of these birds lost its beautiful crimson color upon exposure to a heavy rain, it reappearing only after a considerable interval and when the feathers were dry.

Engineers in the field seemingly would do well to surround their copper-mining prospects with bright colors, to protect them from heavy rains, and, when they are restless at night, to sing them to sleep.

Looking Across Cobalt Lake at the Nipissing Mill, Cobalt, Ontario

Discussion

Anarchy in Mexico

THE EDITOR:

Sir—The killing of C. F. Sturtevant in Sinaloa, as described in the *Journal-Press* of Aug. 9, was as shocking to the outside mining world as was the recent murder of Mrs. Evans in Puebla to many a European chancellory. Yet neither of these events surprised anyone here except persons who confine their observations to the foreign quarter of the capital or see things through the rose-colored lenses of the subsidized press. Since the break-up of the Diaz régime in 1911, outrages like these murders have been constantly happening, and, at present, there seems little hope for any marked change for the better in the near future.

The mistake that most tenderfeet make in Mexico is to imagine that they are dealing with a civilized people similar to those of the United States or Western Europe. In this illusion they are encouraged by constantly hearing certain formulæ of courtesy, originally introduced by the Spaniards but now prevalent even among the lowest class of peons in their social intercourse. In all cases this politeness smooths the passage of the moneyed foreigner, and sometimes he may finish his visit and return home without ever having seen any reverse side to his first favorable impression. Yet the existence of such a reverse side is usually not long concealed from the mining man who has to work with the natives in production and not merely spend on them his holiday money by traversing the country in a Pullman car and stopping at tourist-catering hotels in the big cities.

The foreigner may live for years in a fashionable suburb of Mexico City and never know anything of the native population. He will see little difference in his physical or human environment from what he would find in Madrid, Lisbon, or any other large city of Latin Europe. If he speaks English, French, German, Italian or Syrian, he may even dispense with a knowledge of Spanish and find little difficulty in either business or social relations.

Far different is the lot of the foreign mine operator, executive, or engineer when obliged to live in a mining camp or small town far from tourist routes and ruled by natives unaffected by cosmopolitan influence. After a few months of such a life, he begins to realize that he has to deal with an Indian rather than a Caucasian culture, and adapts himself to that fact. The culture varies in different parts of the country; in some it is close to the Spanish civilization of the eighteenth century; in others it has changed little from the middle stage of barbarism in which the Aztec tribes were living when first seen by the white invaders in 1521.

The chief social characteristic of the barbaric or even the savage epoch of culture is not ferocity, ignorance, or stupidity but rather the lack of that co-operative spirit which impels the individual to subordinate his animal impulses for the common good. This co-operation is present in civilized nations among the masses as a result of centuries of discipline due to a slow development, from the tribes of primitive mankind, through the feudal district, the city-state, the national kingdom and the empire of various nations, to the most modern form of the federalized republic. In Indian nations like Mexico and others of Latin America, where a civilized organization was first forced upon aboriginal tribes by the Iberians of the sixteenth century, the masses have, even now, not developed sufficiently to fit the artificial constitutions which their *doctrinaire* leaders adopted for them, a century ago, in imitation of the Great Republic. As civilized law and order is beyond the ken of the masses, left to themselves, it can exist in any of these nations only when the government is a centralized oligarchy with sufficient administrative ability and military power to force its will upon the country at large.

Such a government was enjoyed by Mexico during the thirty years of the Diaz régime, which, whatever its defects and mistakes—and they were many—insisted on the subordination of the barbaric impulses for loot and anarchy to the necessities of a civilized industrial system. In the early days of railroading many a village was punished summarily for stealing ties or otherwise interrupting traffic, while the *rurales*, originally bandits, were used to hunt down rustic criminals persistently and relentlessly.

While her misfit republican constitutions have so often caused independent Mexico to be the victim of military adventurers and civilian demagogues, it is only by the present revolution that her administrative machinery has been legally disorganized. Following the Latin system of Europe, every Mexican state was formerly divided into districts or cantons, each ruled by a prefect or *jefe politico* appointed by the Governor. The prefects corresponded somewhat to sheriffs in the United States, and with them as local representatives, to manage the *gendarmes* of the cities and the *rurales* of the countryside, a Governor was able to unify the police system of his state.

The Constitution of 1917 destroyed this ancient and efficient organization for policing a state without substituting anything in its place. The division into cantons—corresponding to American counties—was abolished, and, instead, was set up, as a unit of administration, the "free" municipality or township. In the larger cities, the residence of the bulk of civilized Mexicans, order is maintained as before by means of the *gendarmes* to enforce the decrees of the state and local courts. It is in the small towns and villages that the baneful effects of the disorganization are apparent.

Left to their own devices, without the former police control from the more cultured cities, the rural municipalities, which comprise the bulk of the population as well as the area of the country, are in many cases rapidly relapsing into the barbarism of Aztec times. Each free municipality is now ruled by an *ayuntamiento*, or elected council of aldermen, with a *presidente*, or mayor, as executive officer. In primitive towns, the councils have no concrete idea of what constitutes a civilized penal system. In more cultured towns the

councils are now hindered from enforcing such a system by the lack of funds.

Owing to the fact that public revenue is still collected, as formerly, mostly by indirect taxes such as the customs tariff and the stamps on production and consumption—and is thus easily diverted to the army and the expensive national and state bureaucracies—little is available for the use of the rural municipalities. This poverty hinders both the arrest and the punishment of criminals. The former because the only rustic police (the *rurales*), formerly paid by the federal and state governments, have been abolished by the present revolution; and the latter because the extra expense of running the municipality under the new organization has tempted the councils to substitute fines for incarceration or execution.

Many municipalities have now no better force for catching the worst criminals than a few wretched Indian amateurs, sent out, without even expense money, by their village headman. Should such a criminal be caught, he is released from jail just as soon as he has secured enough local influence or cash to satisfy the council. Even cold-blooded murderers are treated in this fashion.

During the Diaz régime, the feudal landlords were allowed to continue an illegal system of peonage and also to despoil a great number of Indian villages of their ancient communal land reservations or *egidos*. This agrarian injustice was perhaps the chief economic cause of the present revolution, but the practical remedy prescribed by Article 27 of the Constitution of 1917 has, so far, been worse than the disease. Not only are the *egidos* to be restored to the thousand or so of despoiled villages, but 14,000 other villages which have had no *egidos* for generations, or never had any, are to be now furnished with them, mostly from the neighboring private ranches. Unless a landlord can show a clear title back to 1857, his land may be seized without payment; even with a sound title he must take in payment, for an *egido*, government agrarian bonds, which have little or no actual market value.

The people worse affected by this destructive agrarian policy have not been the great feudal landlords, for these had a plethora of *undeveloped* land, but the owners of land bonds and the middle-class owners of improved farms. Incited by political agitators, who find demagogy the most profitable of trades, the villages have demanded, and often secured, irrigated and other highly improved lands for their *egidos*. And such lands have generally been improved at the expense of middle-class bond holders or land owners. Besides these classes, bank creditors have suffered greatly, especially in the State of Morelos, where the distribution of the irrigated sugar lands (formerly worth 3,000 pesos a hectare) to the villagers means the loss of millions by the Mexican banks which financed their development.

But the worst effect of this agrarianism has been on the villagers themselves, who, never blessed with any clear sense of the moral rights of property, are rapidly getting to have none at all, for they are receiving these valuable lands gratis and are also exempted from the direct property tax. Formed into armed predatory bands, many villages have not only driven out or murdered any middle-class residents who objected to the growing anarchy, but have seized, without governmental sanction, the neighboring farms with growing crops and killed their owners or managers. The most fully "agrarianized" states—Morelos and Yucatan—have long ceased to be self-supporting and maintain their state officials only by means of federal subsidies.

The last, but not least, inciter to anarchy in the new constitution is Article 123, which is based on the program of European revolutionary syndicalism. One clause authorizes violence in labor disputes, if performed by only a *minority* of the strikers, while another clause gives *unlimited* power, in each municipality, to a local arbitration commission to fix the wage rate for each enterprise and divide its annual profits between owner and workmen. This means in practice that the owner is merely a manager at the mercy of the whims of an arbitration commission of politicians. Judging from the disastrous effects of Article 123 where partially applied, in the states of Yucatan and Vera Cruz, its full application everywhere would wreck the industries of Mexico as completely as Marxian communism has ruined those of Russia.

In the future such revolting crimes as the Sturtevant and Evans murders will tend to become ever more frequent as long as the disorganizing articles of the new constitution are not amended according to the hard-won experience of fifty centuries of human civilization. As yet Mexican politicians propose only to "regulate" the pernicious articles, which is mere trifling. Because, even should one Congress succeed in "regulating" immorality and destruction into their opposites, the next Congress can even more readily reverse the process as long as the original articles remain unchanged. Without radical amendment there can be no security for the future, and Mexico must abandon all hope of further progress toward civilization. ROBERT BRUCE BRINSMADE.

Mexico City, Mexico.

Gold Veins of Central Idaho

THE EDITOR:

Sir—So excellent a paper as that by Francis A. Thomson, on "Gold Veins of Sundry Areas in the Idaho Batholith," which appeared in your issue of Oct. 4, deserves commendation. The author gives a clear view of his subject matter, unobscured by the thicket of technology which forms so prominent a part of many current geological papers.

It has been well said that the purpose of science is to search out, amid complexity, whatever is common and general, and to set it apart from that which is diverse and accidental. This Thomson does. He relates all of the gold veins to the shell of the granite batholith, including in the term "shell" both the outer part of the granite mass and the immediate covering of gneiss and schist. He points to a distinct, closely related aggregate of phenomena which is found within this shell. The group includes aplite dikes, pegmatite dikes, veins of "bull" quartz, fractured gold-bearing veins containing sulphides, and basic dikes. He shows that erosion to a depth of 2,000 ft. below the cover of the batholith into the granite leaves only the ramifying roots of dikes and veins, and that deeper erosion removes even these.

The inference is clear: a splitting process took place within a portion of the batholith now open to view. A part of the magma was driven into two separate poles, one acid, the other basic, and the ores were formed as one result of the process. This framework, with a due allowance for secondary processes, supplies a fair basis for Thomson's judgment on any one particular vein. It furnishes a support for his reasoning on the probable

extent of the vein in depth and warrants some forecast as to the quality of the ore that may be expected within the oreshoots.

This paper is more or less an abstract of a report on the "Geology and Gold Resources of North Central Idaho," by Thomson and Ballard, which has been recently issued from the Idaho Bureau of Mines and Geology. The report is quite as readable as the abstract. The maps accompanying the report are excellent, although two of them would be more useful if they had been furnished with scales to determine distances. It is usually possible to find readily on these maps any place mentioned in the text, which is a virtue in maps. The landscape sketches that are also included bring to mind. a shadowy semblance of the old placer days, beyond the capacity of the camera.

Contrary to the custom in most reports, the authors refuse to make a fetish of the microscope, but indicate that field relations may be quite as important in classifying rocks as mineralogical detail.

Taken altogether, the work shows discrimination because it casts out the non-essential. More important, it possesses a certain unifying power, thereby lending clarity and precision to the hypothesis concerning the relation of gold veins and batholithic intrusions.

Minneapolis, Minn. HUGH M. ROBERTS.

Board of Tax Appeals

THE EDITOR:

Sir—A recent ruling of the income tax unit and a solicitor's opinion of the Treasury Department illustrate how important it is that engineers should participate in the solution of income tax problems involving natural resources. There may be a distinction in the mind of a lawyer between the right to remove oil from land and the actual ownership of the oil, but an engineer properly disregards any distinction in making a valuation of a taxpayer's interest. The exclusive right to remove oil from land for as long a period as it may be found in paying quantities is just as valuable as the ownership of the oil itself, and there should be no discrimination in applying income tax laws such as now confront us.

Although the law and regulations define "capital assets" to mean "property of any kind whatever acquired and held by the taxpayer for profit or investment," a taxpayer who sold a portion of the oil and gas in his land was recently held to be not entitled to the benefit of the capital gain section of the revenue act of 1921. This taxpayer, prior to the sale, owned 100 per cent of the oil and gas in his land. He sold the greater part of it for a sum of money. He parted with and lost the portion sold just as effectively as though he had sold a certain described parcel of his land. That portion which he did not sell he retained as royalty oil and gas. It certainly was not an engineer who ruled that "no sale or exchange of capital assets has been effected" by this transaction.

In another recent case a taxpayer who in reality owned a definitely described interest in a mine was denied a depletion deduction in a solicitor's opinion of the Treasury Department. This taxpayer originally acquired the exclusive right to mine on certain land—in other words, ownership of the mineral. A mining company agreed with the taxpayer to operate the mine and to pay the taxpayer one-twelfth of the net profits; by this transaction the taxpayer disposed of a part of his mineral but retained a one-twelfth working interest in the mine. Although the agreement stated that it gave the taxpayer no interest in nor any right of control over the lease, he is a partner with the mining company and his property is being depleted just as certainly as is the property of the company and the land owner. An engineer would not have ruled that "the income of the taxpayer was not derived from an interest in the mining lease" and that "he is not entitled to a deduction for depletion." S. L. GILLAN.

Los Angeles, Calif.

Why Waste Natural Resources?

THE EDITOR:

Sir—In the *Journal-Press* of Oct. 4 are two editorials which in the author's mind evidently had no connection with each other. But on closer reading they will be found to consider the same matter, but from exactly opposite sides. I refer to the editorials on "Conservation" and "Katanga's Hot Pace." The statements are respectively made that "from a national viewpoint the sound policy would be, at first sight, to buy metals from whichever source they could be obtained most cheaply, whether at home or abroad, but . . . this cannot be safely held as the only consideration," and that American copper producers can easily beat Katanga's production, but that "thirteen-cent copper is no inducement to remove the brakes, and other mining companies are wise in conserving their assets."

It appears to me that the last statement applies just as strongly to national resources as to those of the copper companies which have purely natural resources. Government management is notoriously inefficient, and it would be well if it were to follow the economic reasoning of the large copper producers: to "conserve their assets" until more favorable conditions prevail.

The amount of mineral wealth in the world is limited. Some countries have been treated more bountifully by Nature than others; the United States, perhaps, has been the most fortunate of all. But even we, in certain cases, have a paucity of some of the important metals which we can buy much more cheaply abroad than they can be produced at home. By all means, then, let us buy them—let us exhaust some one else's resources rather than our own.

Consider the case of iron, as the editor suggests. The world's supply of high-grade, low-phosphorus iron ore is exceedingly small. Especially is there but a small amount in the United States—not enough for domestic needs in the making of low-phosphorus iron. Most of our supply is imported from Spain, North Africa, and a small amount from Sweden. To augment the supply, low-phosphorus pyrite residue from sulphuric acid and fertilizer plants is used, but even much of this comes from Spain and Canada. In recent years concentration of siliceous magnetite of the eastern Mesabi range has been resorted to, but this can be commercially successful only with an active protective tariff. On the whole, we supply about 60 per cent of the material needed for the manufacture of our normal output of low-phosphorus iron. But since we can also purchase that 60 per cent at a price lower than we can produce it, why should we be gradually depleting our own too small reserve? It would be much wiser to conserve it and buy from the rest of the world until it comes to us begging for material at our own price. SAMUEL G. LASKY.

Denver, Colo.

News of the Week

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Summary

PHELPS DODGE officials deny rumors that the corporation expects to sell, or is negotiating for the sale of, its copper mining properties in Arizona and New Mexico.

The Hedley Gold Mining Co. is crushing 240 tons of ore daily from the Nickel Plate mine in the Similkameen Valley, British Columbia.

Reconstruction of its concentrator by the Yellow Pine Mining Co. at Goodsprings, Nev., is progressing.

A fire on Oct. 29 destroyed the wooden headframe at the main shaft of the Eureka mine, at Ramsay, Mich.

Excessive water has stopped sinking operations at the Cresson gold mine at Cripple Creek, pending the installation of new electrical pumps.

W. J. Loring, who recently assumed management of the Princeton mine, in California, will sink the shaft below the 1,600 level.

The United Verde Extension, operating at Jerome, Ariz., has drifted 185 ft. on the new orebody opened on the 1,600 level.

Oklahoma court decides that concentrate stored at mills is taxable as personal property.

Portland Canal Operations Will Slacken During Winter

Improvement in Development in Past Season—Good Samples from Monroe Property—Dunwell Shares Active on Exchange

The season in the Portland Canal district, in British Columbia, is drawing to a close, and those properties that are not equipped to carry on work during the winter are closing down until next spring. The season has been a successful one, some important new discoveries have been made, and some good work has been done. Systematic exploration has been done at the Rufus mine, at the head of Bear River, under the supervision of Martin Whitworth. A wide belt carrying a network of veins has been opened over a distance of 3,000 ft. More than 150 assays were made, and they range from 8 to 600 oz. of silver and a trace up to 25 per cent of lead. As soon as weather conditions permit, work will be resumed in the spring, when a tunnel will be driven to explore the belt at depth.

The Porter-Idaho Syndicate has opened a number of promising veins on its property on the north fork of the Marmot River and has shipped 175 tons of ore, won in development. The first 30 tons gave a net return of $164 per ton in silver and lead; the returns for the remainder have not yet been received. Work has been suspended until next year; during the winter the company will be financed, with a view to operating on a larger scale next season. Transportation facilities will have to be improved; the shipment made this year was transported to tidewater by pack train.

Good reports continue to come from the Dunwell mine, which holds first place in favor on the Victoria Stock Exchange, $1 shares being quoted around $5, but the reports lack specific information.

A vein 2½ ft. wide showing native silver and argentite freely has been cut by a tunnel on the Glacier Creek group, adjoining the Dunwell. A 2-ft. vein of quartz, carrying freibergite and galena and assaying $5.60 in gold, 283 oz. in silver, and 216 lb. in lead per ton, has been traced for 1,000 ft. on the Munroe group, to the west of Salmon River Glacier.

Yellow Pine Mining Co. Builds Concentrator in Nevada

THE Yellow Pine Mining Co. of Goodsprings, Nev., which lost its concentrating plant by fire on Sept. 19, 1924, has the work of new construction well under way. It is expected that the new plant will be in operation early in 1925. In the meantime ore shipments are going forward to the smelters at the rate of 1,500 tons per month. The regular quarterly dividend of 4c. per share was paid on Sept. 25 to stockholders on record as of Sept. 15, 1924.

Magma Copper Issues Additional Stock to Provide Capital

The Magma Copper Co. has increased its outstanding stock by 5,150 shares, making the total now outstanding 245,150, out of an authorized amount of 350,000 shares. The new stock has been sold to provide additional working capital. Production is going forward at the rate of about 3,000,000 lb. of copper monthly.

Phelps Dodge Officials Deny Rumor of Contemplated Sale

No Negotiations Under Way — Newspapers in Arizona Have Circulated Reports That Properties Will Be Disposed Of

Denying unequivocally that the Phelps Dodge Corporation is negotiating with another copper company for the sale of its holdings in the southwest, P. G. Beckett and Cleveland E. Dodge, vice-presidents of the corporation, recently set at rest rumors which have been circulated in Bisbee and other cities.

Mr. Beckett said in part: "It is not the policy of this company to attempt to deny irresponsible rumors circulated from time to time regarding its properties and plans, but in view of a fresh crop of rumors recently started with reference to Phelps Dodge corporation intending to dispose of its mining holdings, it seems proper, in fairness to its organizations and to the communities in which it is operating, to state officially that these rumors have no foundation in fact. Walter Douglas, president of the Phelps Dodge Corporation, has authorized me to officially deny these statements and to say unequivocally that there is absolutely no basis for such rumors."

The rumors referred to recently appeared in several newspapers in Arizona, which stated that the Phelps Dodge corporation was negotiating with another large copper company for the disposal of its properties with the exception of its holdings in Mexico. These include mines, mills and smelters at Bisbee, Clifton, and Douglas, in Arizona, and the Burro Mountain property at Tyrone, in New Mexico, which has been inactive for some years.

New Orebody in United Verde Extension Mine

THE cutting of a diamond-drill station on the 1,600 ft. level of the United Verde Extension mine at Jerome, Ariz., has resulted in the finding of a new and important orebody. When the station was cut the northeast wall was found to be in ore, and drifting was immediately begun. The drift is now 185 ft. long and is all in ore assaying from 8 to 12 per cent copper. Several geologists have maintained that the main Extension orebody is secondary, but the new discovery is definitely primary. It is extremely dense and heavier than anything heretofore opened in the mine. The new orebody is about 250 ft. to the northeast of the original one. Exploration will be continued to determine its limits as rapidly as possible.

Parral, Old Mexican Silver-Gold Camp, Is Reviving

Consequently to the death of Manuel Chao, the bandit, and the inactivity of Hipolito Villa, there has been considerable of a revival at the old gold and silver camp of Parral, in Mexico. The district, which has been one of the steady producers for 300 years, fell into decadence during the revolutionary activities, but during the last few weeks a number of companies have revived operations.

The companies operating are largely American. Recent reports state that high-grade ore is again being brought to the surface. New machinery is being sent into the camp and several abandoned properties are being unwatered. Concentrates are being shipped to Amsterdam, despite the high cost of freight.

W. J. Loring Assumes Management of Princeton Gold Mines Co.

W. J. Loring, of San Francisco, has become managing director of the Princeton Gold Mines Co., which is under control of Messrs. Kelso and Holmes. The latter took over the operation of the Mariposa grant and prepared to first work the old Princeton mine at Mount Bullion. Loring has recommended the enlargement of the Princeton shaft to three compartments, and deepening it below the 1,600 level, which was the deepest point reached by the old workings. Leasers on other parts of the Mariposa grant are to be provided with small mining plants, and provision will be made to treat the ore produced by leasers in the Princeton mill.

Respecting the Plymouth Consolidated Gold Mines, Ltd., Mr. Loring says that the E. J. Longyear Co. has sunk the Plymouth shaft from the 3,400 to the 4,100 level, and that plans are now under consideration to sink the shaft to the 4,300 or 4,500 level. Water for milling is now available, and the present milling rate of 100 tons per day will be increased to the normal rate of 300 tons per day.

Empire Mines Co. Begins Development of Sultana Ground

Recently Acquired from Crocker Interests—Hope To Increase Life of Enterprise

The Empire Mines Co., which recently acquired the Sultana group of claims southeast of its present holdings, near Grass Valley, Calif., has begun work on the new property. Development and exploration will be extended at depth from the levels of the Empire Mine group and supplementary work will be done in the Sultana shaft. The Osborne Hill claims were closely held for a long time, and plans to develop the area extensively were delayed by the readjustment occasioned by the San Francisco fire in 1906.

The plans were initiated by Charles A. Brockington, who was manager at the time. The Prescott shaft, which was sunk to a depth of 1,800 ft. in furtherance of the general plan of deep development, was allowed to flood. Later it was unwatered, but again abandoned, and little work was done since then. Ownership finally centered in the Crocker interests.

The Empire interests recently took over the property. Their holdings are greatly increased by this accession, and the possibilities of the new area, which are considered to be good, will insure added life to their enterprise.

Will Build Furnace to Bake "Zonolite" in Montana

A furnace for baking the output from a deposit of phlogopite is being built by the Zonolite Co. at Libby, Mont., according to E. N. Alley, who heads the company. The mineral, which is a magnesia-mica variety of biotite, must be baked to make it suitable for the uses which have been developed thus far. When baked the material is fireproof to a comparatively high temperature. It forms an excellent insulator against heat or cold. It has been used as a filling in the hollow walls of safes, bake ovens and kilns, and in cold-storage plants at sea and on land.

The raw product, of which there is a large reserve, is covered by only a few feet of overburden, and can be mined cheaply. It has the characteristic appearance of dark mica, but when subjected to heat it exfoliates and expands to light, fluffy flakes of a golden color. The ratio of bulk in the raw material as compared with the heat-treated materail is about 1 to 15. Little weight is lost in processing.

Cresson Will Have Big Pump Station at 19th Level

The Cresson Consolidated company, operating at Cripple Creek, Colo., has stopped sinking on account of a heavy flow of water in the bottom of the shaft, and is lifting about 1,400 gal. of water per minute. The 19th level, at 2,496 ft., is being cut, where the large electrical pumps will be installed, after which sinking will be resumed. As the development of the 18th level proceeds, additional ore reserves are being discovered with the extension of the laterals. About 10,500 tons of ore are being sent to the mill monthly.

Stored Mill Concentrate Is Taxable Personal Property

A DECISION of importance to a number of mining companies in the Oklahoma section of the Joplin-Miami district was made by the supreme court of that state on Oct. 21, to the effect that ad valorem taxes on ore held in bins must be paid by companies whether they are operating on restricted Indian lands or not.

The suit was one wherein the Jaybird Mining Co. had paid $2,319 of such taxes to the treasurer of Ottawa County under protest, and was asking the return of the money. The court held that ore already mined was the personal property of the mining company and not subject to the exemptions granted Indian allottees or their representatives.

Rehabilitate Promotorio Mines in Durango, Mexico

Rehabilitation of the Promotorio mines, situated in the State of Durango, Mexico, has just been authorized by the Compania Negociacion Minera de Promotorio. These mines have produced many millions of dollars of rich ore. They were acquired and developed many years ago by the late Maximiliano Damm, of Durango. When he died they passed into the hands of his sons, and they organized the present company. The property continued to be worked until revolutionary activities caused operations to be suspended several years ago. Since then water has accumulated in the lower workings and the machinery and equipment have deteriorated. Preparations are being made to install much new machinery and to reopen the mines.

Wooden Headframe at Eureka Mine, in Michigan, Burns

The wooden headframe at the main shaft of the Eureka mine, at Ramsay, Mich., was nearly destroyed by fire the evening of Oct. 29. The fire started at the stockpile landing about 30 ft. above the collar of the shaft, and spread rapidly through the dry timbers to the top of the shafthouse. It burned the hoisting ropes off. The safety dogs caught and held the cage at the collar, but the skips went down the shaft, causing some damage there. The headsheaves fell to the deck of the stockpile landing, where the fire had been checked and was finally extinguished.

As the fire occurred before the night shift had gone underground, the only men in the mine at the time were the pumpmen, and they were away from the shaft, so no one was hurt by the falling skips. The pumpmen had exit through either the Asteroid shaft or the No. 3 Eureka shaft, but it is impracticable to handle ore through these exits, so the mine will be shut down until the headframe can be rebuilt, probably for a few weeks. Meanwhile more than a hundred miners will be out of work.

Bay Horse Will Sell Shares to Build Mill

At a recent meeting of the stockholders of the company operating the Bay Horse mine, near Huntington, Ore., the shares of the company were increased from 3,000,000 to 7,500,000 and a contract was signed with Carl N. Anderson, mining engineer, and Joseph Stewart, of Pittsburgh, for the sale of 3,000,000 shares to net the company $240,000 for the purpose of building a concentrator at the mine. A large tonnage of ore has been blocked out in the last two years. Work will begin soon.

Hamilton Development Discontinued for Winter at Least

The Tonopah Mining Co. has discontinued work at the old camp of Hamilton, where it holds options on a large acreage of what was formerly the most productive portion of Treasure Hill. Part of the equipment has been stored in Kimberly for the time being, and the heavier machinery left in place at the mines. It is reported that the company may resume work in the spring, when climatic conditions are more favorable for work than during the cold winter months.

New Road Helps American Fork Canyon Mines in Utah

Activity in American Fork Canyon, Utah, is being stimulated by the new road up the canyon, built by the American Leasing Co. The Live Yankee property, which, with the Silver Wave and Belorophon, is being operated by the American Leasing, can now be reached by automobile; and high-powered cars can go as far as the Mary-Ellen. The latter is using a gravity surface tramway to connect with the road at the Yankee.

The grade of the new road is easy and even, and it is built on the side of the canyon, so that it is protected, as far as possible, from snows and can be used during the winter. Properties working besides those of the American Leasing and the Mary-Ellen, include the Pittsburg and Pacific. The Pacific, which has a car of ore ready for the market, is preparing to install a hoist.

The American Leasing Co. has developed considerable ore, and is shipping steadily. The Pittsburg also is said to be shipping. A car from the Mary-Ellen is ready for the market.

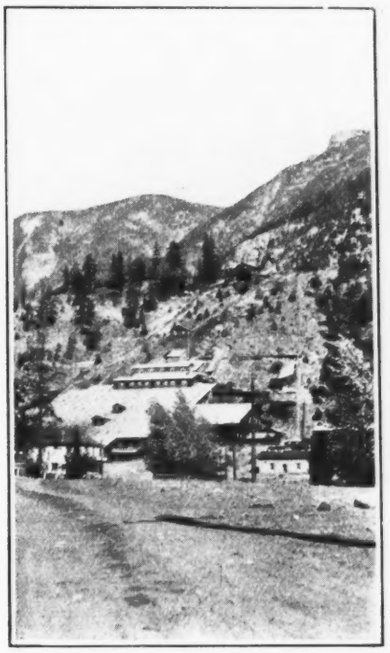
Bethlehem Shipbuilding Corporation Will Drill Dredging Ground

The Bethlehem Shipbuilding Corporation, Ltd., of San Francisco, has made preliminary investigation of dredging ground on the Peace River, in British Columbia, close to the junction of the Finlay River and within 20 miles of Mount Selwyn. The investigations are to be extended and thorough drilling will be undertaken if the results of the preliminary investigation are satisfactory. The corporation will undertake to finance dredge construction in the event that the investigations indicate satisfactory gold values.

Hedley Gold Mining Co. Mills 240 Tons Daily

Cyaniding and Concentration—Arsenic Recovered at Tacoma Smelter—$8,000,000 Production Record

The Hedley Gold Mining Co. is making a profit in its operation of the Nickel Plate mine, in the Similkameen Valley, in British Columbia. In the mill forty stamps are dropping twenty-four



The Nickel Plate concentrator at Hedley, B. C.

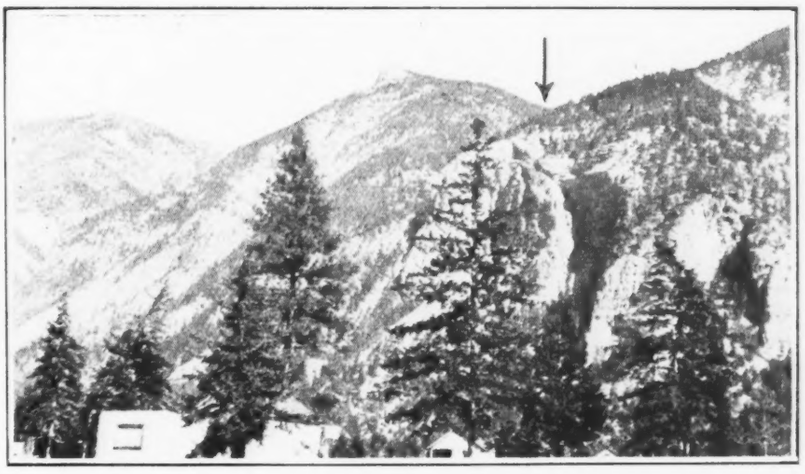
hours daily, crushing about 240 tons of ore. Operations were resumed recently, after a period of idleness. The Nickel Plate is an example of a large mine which has been in operation for many years without the usual sprinkling of neighboring small mines and prospects which usually accompany larger mining operations. The mine up to 1923 has produced about $8,000,000 gross, the average value of the ore, according to government reports, being $9.50 per ton in gold.

The ore is arsenopyrite carrying gold and occurs in masses or lenses usually associated with diorite or gabbro sills which have invaded the limestone formation. The orebodies vary from 200 to 600 ft. in length, with varying width. The values are highest near the contact and fade out gradually into the limestone, so that the other wall is usually defined by the limit of commercial ore. In places the orebodies have been mined for 60 ft. in width.

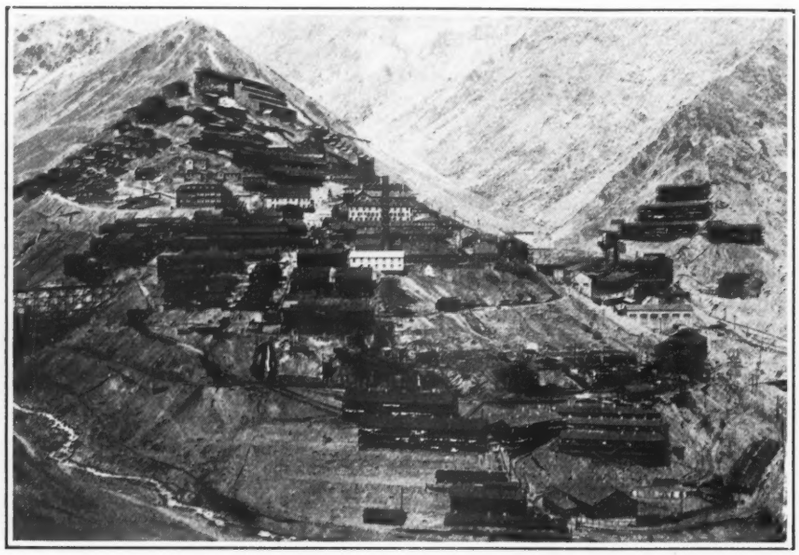
The mine is in the high mountains, about five miles from the town of Hedley, where the concentrator of the company is situated. Present mining operations are at the bottom of a 1,500-ft. incline shaft. From the collar of the shaft the ore is transported by means of a narrow-gage electric railway about three miles to the head of a surface gravity tram, consisting of two sections separated at the mid-point by a station before the ore reaches the mill bins. The ore then passes through crushers directly to four batteries of ten stamps each. Four 22-ft. tube mills grind to about 150 mesh for cyanidation. The ball mill "pebbles" are collected by the crusherman from the harder pieces of ore. The tailing passes over a series of vanners and tables where the heavy arsenopyrite is collected and the concentrate shipped to the Tacoma smelter, where the remaining gold and arsenic are recovered.

Heroult Electric Smelter and Mine Leased

M. A. Luce, general manager of the Universal Electro-Reductions Corporation and also manager of the Shasta Iron & Steel Corporation of Oakland, Calif., has leased the Heroult plant and iron mine at Heroult, Calif., both owned by the Noble Electric Steel Co., which went into the hands of a receiver in February, 1919. The lease carries with it an option to purchase both properties. The Shasta Iron & Steel Corporation plans to operate the plant at Heroult, and expects to mine iron ore and limestone. The electric smelter is to be operated on ferro-alloys and steel products.



The location of the Nickel Plate mine is indicated by the arrow



Sewell, main settlement of the Braden Copper Co. in Chile

The mill is at the top of the center hill. The smelter is seven miles down the valley. At the left, above, is the American town. Seven thousand Chileans work at the plant

Peerless Mines Development Co. Options Two Groups

The Peerless Mines Development Co. operating near Kingman, Ariz., managed by E. E. Campbell, formerly general superintendent of the United Verde Extension Copper Co., has taken over the Fountain Head group, in the Stockton Hill district, and has an option to purchase the Summit group of seven claims.

The first work is to be done on the latter property, on which a contract has been given for a 600-ft. tunnel, which will be connected with a shaft already completed. Eighteen feet of good milling ore is reported in the shaft at the 130 level. Commercial ore also is reported to have been opened at relatively slight depth in the Fountain Head.

Michigan Stamp Mill, Never Finished, Will Be Dismantled

The Michigan stamp mill, on Keweenaw Bay, Baraga County, Mich., is being dismantled and will be permanently abandoned by the Mohawk Mining Co., which is consolidated with the Michigan and Wolverine companies. As much of the machinery and equipment as can be utilized will be retained and the rest scrapped. The high valuation placed on the property by Baraga County entailed high taxes.

In the event that Michigan becomes a producer, its rock will be stamped in some mill in the district which has a head or two idle and is convenient for the company's purposes. The Michigan stamp mill was never completed, and no rock ever was stamped in it. Construction work was started early in 1906 and suspended in 1907 after $175,000 had been spent. In addition to the mill, a machine shop and pump house were built and a tunnel was driven out into Keweenaw Bay. Ten dwellings also were constructed. Before the plant was completed, however, the lodes in which Michigan was working were found to be poor, and the mill project was stopped.

Orogrande Gold Mines Co. Will Build Cyanide Plant

J. E. Pickrell, manager of the Orogrande Gold Mines Co., operating the Hogan mine, in the Buffalo Hump district of central Idaho, says that a 500-ton cyanide plant will be completed on the property by spring. The Orogrande is a large low-grade gold producer on which development has been under way for several years. The zone in which the gold occurs is said to be 300 ft. wide and 11,000 ft. long and carries an average of $3 in gold, with some silver.

Gold Circle Mine, in Nevada, Yields $100 Ore

The Red Hills Florence Mining Co. has shipped a second car of ore from its property at Gold Circle, Nev. Smelter returns are not yet available, but the ore is estimated to run over $100 per ton. This ore was mined from above the 300 level, a part coming from development work. The company expects to connect the 500 to the 300 level, and the 300 to the 200 level, by raises, thereby solving the ventilation problem. The 300 and 500 level drifts then will be driven north to develop another ore-shoot proved on upper levels.

Douglas Tailings at Dayton, Nevada, To Be Worked

D. F. Micklejohn and his associates have leased the Douglas tailings at Dayton, Nev., on a royalty basis and will start the construction of a plant this winter and expect to have it in operation by spring. The tailings represent an accumulation of several hundred thousand tons of old Comstock residues. Many examinations of the pile have been made, but previous negotiations were not consummated or the trials resulted in failure.

Preliminary experiments indicate that a saving of 60 per cent of the gold and silver can be made by flotation. A flotation plant is to be used, and mercury will be recovered in a centrifugal type amalgamator.

Washington News

By Paul Wooton

Special Correspondent

Arrange for Skilled Instead of Unskilled Immigrants

Cornish Miners for Michigan—No Increase in Total Admitted Results from Policy

Officials of the Department of Labor are convinced that it is in the public interest for our industries to bring in from abroad as many skilled workmen as can be used to advantage in those lines of endeavor which cannot be manned completely from our own labor supply. They think the maximum possible amount of the immigration quota from each country should be made up of skilled labor. As it is, the great bulk of the quotas are being filled by those capable of common labor only.

Industries are being encouraged to make application under the new immigration act for permission to make special arrangements for skilled workmen. Some industries have taken advantage of this opportunity. Several applications have been granted to Michigan copper mining companies to bring in mine workers who are particularly conversant with the problems of deep mining. This type of skill is drawn chiefly from Cornwall.

Applications also have been granted admitting Germans specially skilled in the manufacture of dyes, and permitting the entry of specialists in textile manufacture, in the manufacture of electrical equipment, and in a number of other industries.

In this connection it is pointed out that these applications in no way add to the number of aliens admitted. The skilled laborers simply replace a corresponding number of less desirable immigrants.

Much Expected of New Classifier Developed in Idaho

An advance in the metallurgy of the complex lead-zinc ores of Idaho is claimed by the U. S. Bureau of Mines in the development, in co-operation with the University of Idaho, of an improved type of hydraulic classifier. It has been tried out on a commercial scale with the result that a greatly improved classification has been obtained. This, in turn, is certain to result in improved concentration when the tables are fed with properly classified material. It also permits the separation of galena and sphalerite, and much of the fine grinding and difficulties in flotation of these ores may be obviated.

Alsatian Phosphate Output 137,972 Tons in Half Year

According to French statistics just published, the production of phosphate in Alsace during the first six months of the present year amounted to 137,972 tons, compared with 118,980 tons during the same period of the preceding year. During the second quarter of 1924 the production amounted to only 62,152 tons, against 75,820 tons in the first quarter.

Labor One-Half of Cost of Copper Production

STATISTICIANS of the Inspiration Consolidated Copper Co. have figured out the cost of copper production on a percentage basis, and, as a result of their investigations, find that labor amounts to approximately 42 per cent of the total expenditure. Supplies are estimated at 27 per cent; taxes 13 per cent, and miscellaneous and other items make up the balance.

Bureau Will Attack Black Hills "Blue" Ore Problem

Metallurgists of the U. S. Bureau of Mines are attacking the "blue" ore problem in the Black Hills of South Dakota, with a full determination of discovering why so small a portion of the gold in those ores can be recovered. The problem presented has been so baffling that it has been determined to go back to the beginning and develop a comprehensive research program.

Despite the fact that the gold deposits of the Black Hills are comparatively rich, the Homestake is the only property operating in the district at this time. If a process can be discovered whereby a high percentage of recovery can be secured, there is reason to believe that the Black Hills can develop other Homestakes — a mine where more "dirt" has been moved than in the construction of the canal across Panama.

Liquid Oxygen, As Explosive, Makes Progress

Increasing evidence in the studies being pursued by the U. S. Bureau of Mines indicates that liquid oxygen explosives can be used to great advantage in certain metal mines and in quarries. The experiments conducted in Colorado mines and in road construction in that state have disclosed a reduction of 50 per cent in explosives cost. The explosive is now in successful use in the Real del Monte, at Pachuca, Mexico. It is believed that this explosive can be used to advantage at remote mines and those difficult of access, because the oxygen explosive is made on the ground.

Relief!

Five more awards have been made by the War Minerals Relief Commission. The total was $13,822, the largest being to the Los Angeles Manganese Co. of Los Angeles, California. The names of the claimants by states with the amounts awarded follow:

California

G. W. Pelletreau, Big Bar, $532.
Willey, Gorman, Tillotson & Mannelin, Michigan Bluff, $550.97.
Los Angeles Manganese Company, Los Angeles, $7,884.34.

Massachusetts

John F. Campbell, New Bedford, $1,920.48.

Washington

C. C. Alexander, Pasco, $2,935.

London Letter

By W. A. Doman
Special Correspondent

Van Ryn Gold Acquires New Ground From Modder West

Payable Ore Found in Upper Workings —Plant To Be Electrified— Big Saving

London, Oct. 21—For a considerable time Van Ryn Gold Mines Estate (East Rand) has been thought to be nearing the end of its life. Now the whole aspect of affairs seems to be changed. Some of the "leaders" in the upper workings have proved to be payable, and a block of 151 claims (150x400 ft.), mainly the property of the old Modder West, has been acquired. Profitable ore has been discovered on the surface of this ground, and it is estimated that the life of the Van Ryn has been extended by about twenty years. This, of course, assumes that the whole ground will be payable, which has yet to be proved. In any case the shares are being bought, and from lower than 20s., some months ago, they have advanced to 24s. 9d. The electrification of the plant will be completed early next year, and is expected to effect a saving of £10,000 annually.

Gossip has it that Solly Joel contemplates turning over his gold, diamond, and finance interests to the Johannesburg Consolidated Investment Co., the reason given being that he has no heir to his estate, and wishes the market not to be disturbed in the event of his death. It frequently happens that when a "big man" dies, large blocks of shares overhang the market and upset it befor a home can be found for them.

The possibilities of East Pool again becoming the premier tin producer of Cornwall are being discussed. A winze has been sunk 90 ft. in ore averaging 125 lb. of tin and 37 lb. of arsenic over a width of 7 ft. Lack of facilities for handling the product of the mine underground has limited production. Another mine in Cornwall that is pulling round is South Crofty. An increased quantity per ton treated has been obtained recently, and further improvements are expected.

The relative steadiness in the price of tin is bringing forward new companies. I have mentioned one or two of late, and now another—Amari (Nigeria) Tin Mines—is in course of preparation. The object is to take over a property from the Keffi Consolidated Tin Co., which, it is suggested, can be worked best as a separate entity. The capital is £50,000 in 2s. shares, and Bainbridge, Seymour & Co. are the consulting engineers. It is estimated that there are already proved 27,000 tons of ore, averaging more than 35 lb. of cassiterite per ton. There is a lode deposit, as well as alluvial tin.

Hitherto the Ropp Tin Co. has been regarded as owning one of the richest and best of the Nigerian tin deposits. A well-considered plan of development has proved the property for five or six years ahead, and shareholders naturally felt easy as to the future. It is now whispered about that the limit of the rich deposits is known and that the poorer stuff may not prove of a payable character. No official information has been given on the point, but the rumor has reached me from more than one source, so there is no harm in mentioning it.

Edmund Davis is now actively at work with the Rhodesian & General Asbestos Corporation. The company has acquired new ground—namely that formerly belonging to the Rhodesian King, and also the Birthday mine, belonging to the Willoughby's Consolidated Co., and adjoining ground has also been purchased. This means, Mr. Davis says, that the company has a compact group of claims, making it one of the finest asbestos properties known.

Chief "Con" Will Increase Capacity of New Plant

THE concentrating department of the new mill of the Chief Consolidated Mining Co. at Eureka, Utah, has been working with such success that the present capacity—150 tons daily—is to be doubled. This can be done easily, as much of the equipment is such as to be able to handle considerably more than the 150 tons' normal capacity. The volatilization department of the plant also has a capacity for handling more than its nominal tonnage.

Perry Creek Hydraulic Mine Ready to Operate

The Perry Creek Hydraulic Mining Co., owning 600 acres of gold-bearing gravels near Cranbrook, B. C., has about completed preparation for actual mining of the gravels. The work has been in progress for several years.

To bring water to the deposit has required 15,500 ft. of open flume, 1,600 ft. of inverted siphon, 28 in. in diameter, and a long pipe line 36 to 11 in. in diameter. Two giants, with 6-in. nozzles, will work under an 800-ft. head in sluicing the gravels into the boxes.

The deposit is 300 ft. deep, carrying gold, some of which is very coarse, according to A. J. Palmquist, manager. One nugget has been recovered weighing 3 oz.

Half Railroad Freight Is Mine Products

Of the 277,242,083 tons carried by the Class 1 railroads during the second quarter of the current year, 148,482,810 tons was products of mines. This is 19.44 per cent less than the products of mines tonnage in the second quarter of 1923. The total for the second quarter of this year was made up as follows:

	Tons
Anthracite	18,565,810
Clay, gravel, sand and stone	35,776,928
Bituminous coal	62,881,766
Coke	4,301,764
Iron ore	19,708,086
Other ores and concentrates	2,545,118
Base bullion and matte	222,858
Crude petroleum	2,003,627
Asphalt	584,588
Salt	773,521
Other products of mines	1,118,744

Toronto Letter

By Our Special Correspondent for Northern Ontario

McIntyre's New Shaft Reaches 60 Ft. Depth

Concrete Collar—Highest Headframe in District—Prospecting Gamble Property in Quebec

Toronto, Nov. 1—The new 4,000 ft. shaft of the McIntyre is down more than 60 ft. and the concrete collar is now being put in. After that is completed rapid progress is expected. A 128-ft. headframe has been ordered, which will be the highest in Porcupine. The company has a number of men at work on the Gamble option, in Rouyn, Quebec, the chief attention being devoted to a geological survey of the property. A discovery of free gold is reported, but no work has as yet been done on it. It is probable that diamond drills will be brought in over the winter roads and the property explored by this means.

It is understood that the Barry Hollinger, near Kirkland Lake, will erect a 50-ton mill. The property has been developed to 500 ft. and it is planned to carry the main shaft to 750 ft.

The directors of the Everett mine, in Gwoganda, plan to sell the balance of the treasury stock to provide funds for further development of the property.

The Unwrought Metal Sales Act passed by the Ontario Legislature last session to prevent the practice of high-grading came into force on Nov. 1. It provides that no unwrought gold, silver, platinum, palladium or any other precious or rare metal shall be bought, sold, or dealt in except under a license from the Provincial Department of Mines. "Unwrought metal," as defined in the act, includes ores as well as nuggets or "metallics," and generally the metals specified, whether refined or unrefined, or in any form not manufactured into the finished article. The penalty for the first offence under the act is a fine not exceeding $500 and liability to imprisonment for a term not exceeding one year, and for second or subsequent offences a fine not exceeding $1,000, and one year's imprisonment.

Coniagas Mines, Ltd., has started diamond drilling the Porcupine Grande property, at Porcupine, on which an option was recently taken. Drilling done by other interests indicated promising widths and values, but the results will be confirmed before the Coniagas company undertakes extensive underground exploration.

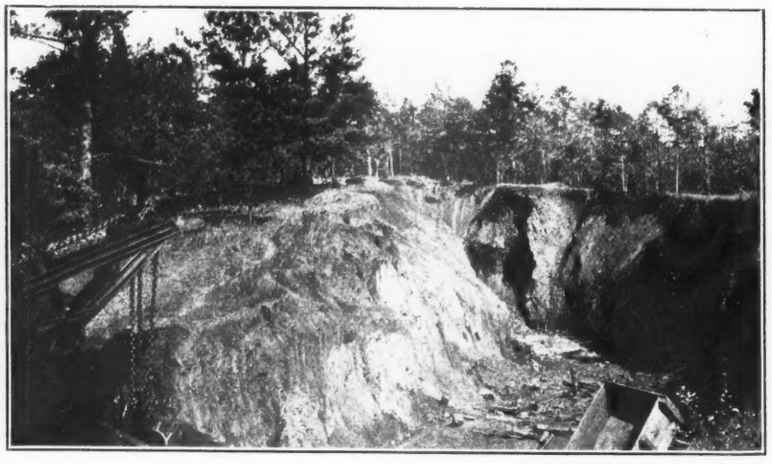
Silver production is normal in Cobalt and surrounding districts, but mines are more prosperous on account of higher prices for silver, and are also treating ore of a lower grade than would otherwise be possible. The Capitol shaft, in Gowganda, is practically completed and development will be started in favorable territory. The South Lorrain railway, nearing completion, will permit mill ore to be shipped to Cobalt for treatment.

The labor situation throughout northern Ontario is satisfactory, with a surplus of men. Plenty of hydro-electric power is available, with no danger of further shortages.

Prospect Cyanite Deposit in Nye County, Nevada

A deposit of cyanite, an aluminum silicate similar in physical characteristics to sillimanite and andalusite, is being prospected in Nye County, Nev., by W. W. Wilson and Fred Remick, of Beatty, Nev., and A. A. Turner, of Houston, Tex. An outcrop of cyanitic schist has been traced for 2,000 ft. in the property. The mineral is characterized by infusability, by high resistance to shock and to extreme temperatures, and by being a non-conductor of electricity when hot.

Laboratory tests are being made to determine the feasibility of using the mineral in the manufacture of spark plugs and electric insulators for high-tension power lines. A somewhat similar deposit near Bishop, Calif., is being worked by interests connected with an important spark-plug manufacturer.



Barytes is mined in the Cartersville district in Georgia by steam shovel

Johannesburg Letter

By John Watson
Special Correspondent

Higher Wages for White Employees on Rand Mines

More Men On Payrolls, Also—Hoisting Engineers (Winding-Engine Drivers) Best Paid

Johannesburg, Sept. 15—A report has recently been published by the Government Mining Engineer showing the earnings of various classes of mine employees in the month of June, 1923, and June, 1924, respectively: Assistant amalgamators, 18s. 7d. and 19s.; amalgamators, 20s. 8d. and 21s. 2d.; "banksmen," 15s. 7d. and 16s. 1d.; drill sharpeners, 20s. 5d. and 20s. 7d.; surface winding-engine drivers (electric), 22s. 1d. and 22s. 10d.; fitters (surface), 20s. 9d. and 21s. 3d.; handy men, 15s. 4d. and 15s. 8d.; pipemen and plate layers, 20s. 7d. and 20s. 10d. These rates do not include the premium bonus, which would increase all the rates in June, 1924, by 5 per cent. The number of Europeans in service on July 31, 1924, was 18,736. The total earnings under all headings during the month amounted to £606,679. The corresponding figures for July, 1923, were 17,541 and £545,790.

A representative meeting of the Marico Amalgamated Syndicate was held in the Town Hall, Zeerust, at end of August. L. E. Ryan, chairman, presented a full report of the work done during the last eighteen months. Shafts have been sunk on two out of four reefs, one to a depth of 68 ft. and the other to a depth of 126 ft. The width of the reef varied from 14 to 20 in. Two samples assayed by the National Bank in Johannesburg yielded 34 and 47 dwt. to the ton. Further samples are being sent for assay.

The Transvaal gold output, for the month of August was declared by the Chamber of Mines on Sept. 10 as 809,571 oz., having a value of £3,683,548. Compared with July, these figures show a decrease of 19,866 oz. and a decrease in value of £183,702. The month of August had five Sundays, leaving twenty-six working days. The daily average output, 31,137 oz., is the best attained this year. The realized price of gold was £4 11s. per ounce, or 2s. 3d. per ounce less than the July figure. The native labor returns for August show an increase of 1424 "boys" working on the gold mines.

Crushing results for August from the leading profit-earning mines follow:

	Tons Crushed	Value, or revenue, £	Costs per Ton Milled s.	d.	Estimated Profit, £
Government Areas	161,000	327,073	16	8.1	195,909
New Modder	124,000	252,869	17	4.5	145,155
Crown Mines	222,000	295,689	18	6.8	89,587
Van Ryn Deep	66,300	135,597	19	3.6	72,548
Modder Deep	44,000	104,405	16	0.0	69,250
City Deep	100,000	175,722	21	11.6	65,901
Modder B	67,500	121,688	18	5.0	59,536
Springs	64,600	123,800	20	9.6	56,613
Randfontein Estates	204,000	234,594	18	0.9	52,642
Geduld	71,000	111,915	18	6.0	46,120
Robinson Deep	75,000	.....	17	4.0	44,856
Brakpan	74,800	122,386	21	1.4	43,427
New State Areas	204,000	108,627	21	11.6	37,533

Mexico City Letter

By W. L. Vail
Special Correspondent

Silver Exchange Situation Improves in Mexican Capital

Monetary Commission Proves Valuable —Production Figures for First Seven Months

Mexico City, Oct. 20—Silver has reached a stable position here for the first time in many months, by the paralleling of the two exchange rates: that of the bankers and that of the Monetary Commission. At the beginning of August silver was so low that a financial panic was feared, and was generally predicted in banking circles, but the situation was saved by the action of the Monetary Commission, which took drastic steps and "fixed" the price of silver, maintaining its price against attacks on the part of certain well-known financial concerns.

When the commission took its stand, silver was at the rate of 6.50 and the commission fixed an arbitrary rate of 3 per cent, with the result that after a few days exchange brokers and banks were forced to follow its lead. On Sept. 1 the exchange values quoted by the bankers and the commission reached the same rate—2.25. Later, there was a slight drop, but a quick recovery, and at this writing quotations run a close parallel.

The trouble was due to a subtle undermining of confidence in the silver peso. It was reported that the market was greatly overloaded with silver and that the government was coining excessive quantities. The Secretary of the Treasury demonstrated by actual figures that the silver in circulation was not only not excessive, but that in many of the interior parts of the republic there was a shortage. With the laying of the bogie, the bottom was knocked from under the speculators and public confidence was restored.

Production of the principal metals in the country during the first seven months of the present year is given as follows:

Metal Production in Mexico, in Kilograms—1924

	Gold	Silver	Lead	Copper
January	2,088	217,351	12,690,378	3,666,361
February	2,048	213,620	11,248,387	3,062,305
March	2,048	258,519	12,297,626	4,319,946
April	1,991	226,950	12,977,292	4,071,712
May	1,992	248,048	14,635,394	4,858,022
June	2,047	211,947	15,127,143	2,264,423
July	2,072	220,092	14,146,327	2,564,423

An important development in mining circles is the plan of the Société de la Vieille-Montagne, of Belgium, to enter actively in business here, with the construction of sundry plants at strategical points in the republic. This organization is the largest zinc concern in Europe and heretofore has depended largely on Australia for metals, aside from the one mine of Moresnet, worked in Belgium. The capital of the company is listed at 300,000,000 fr. It has for some time been securing options on various zinc properties throughout the country.

The report is confirmed that the El Toro property, in the district of Zacualpan, State of Mexico, has run into 25-kg. silver ore and there has been a flurry in stocks. The shares are almost exclusively owned by local British and American interests.

Australian Letter

By Our Special Correspondent for Queensland

Losses of Chillagoe, a State Enterprise, Now £200,000

Smelter To Run Only Six Months a Year—Mount Isa Mines Will Sink to 300 Ft. on Three Leases

Brisbane, Sept. 29—The Queensland State mining enterprises are all turning out disastrously from a financial point of view. More than one has come to an untimely end. The most important one still operating is the Chillagoe Smelters, which was bought from the Chillagoe company about four years ago. Although the main object of the acquisition was to help the mining industry of the far north, both the Minister for Mines and the general manager of the concern were sanguine that it would prove a financial success. One low-grade copper mine (the Eainasleigh) that was taken over with the smelters was soon worked out, and was abandoned more than a year ago. Several mines at Mungana and Chillagoe were acquired, in the hope that they, with what the privately owned mines could do, would keep the smelters supplied with silver, lead, and copper ores. The Mount Mulligan coal mine and coke works also came into the hands of the government in 1923, and all these are now being run conjointly as the Chillagoe state enterprise.

Up to the end of the financial year in June, 1923, the accumulated loss on this enterprise was nearly £200,000. Owing to an insufficiency of ore supplies, during the last year, just closed, the smelters could be run only intermittently, and now it is proposed to have them in operation only six months in each year. The Mount Mulligan mine and works, which is supposed to supply the smelters with fuel, but which does so only in part, records a loss in the last twelve months of over £17,500. It costs more to produce the fuel than is paid for it.

At the Mount Isa silver-lead field the principal of the two operating companies—the Mount Isa Mines, Ltd.—has decided to continue its prospecting campaign from a depth of 100 ft. to 300 ft. in three of its leases that carry the most important lodes. In one of these—the Black Rock—20 ft. of good high-grade ore has been passed through, and the mine is looking particularly well. From the Out on Her Own lease, held by the Proprietary company, a great improvement has been reported within the last week. Veins of rich ore have gone down very regularly, and are continuing to increase in size. It is believed that operations have cut through the leached zone.

New Placer Find Depopulated Small Town in Yukon

REPORTS from Carcross, Yukon Territory, state that practically the whole male population of the town set out for a new placer strike in the vicinity of Little Atlin Lake, 40 miles from Carcross and 20 from the old Tagish Post. A number of prospectors are on their way to the diggings from Whitehorse and Skagway.

The new strike is within 60 miles of the Engineer mine. It was discovered by an Indian and is said to be ideally located between two creeks that give an ample supply of water for all purposes. The gravel is said to average around $4 per pan, the gold being in flakes running from 50c to $1 in value. Indians have staked the best claims. The inhabitants of Carcross all succeeded in staking claims or in acquiring an interest in claims.

Church spires and smelter smokestacks are both seen on the horizon at Pachuca, Mexico

Situation at the Mines

By Arthur B. Parsons
Assistant Editor

AT THIS WRITING the metal-mining situation looks rosier than it has for several months—not that it has been gloomy, but that it is now brighter. Production is at a comparatively high rate, new properties are being opened or reopened in the lead-silver, zinc and lead-silver-zinc districts, and prospecting and development, particularly in silver regions, is unusually active. Perhaps the biggest factor is the high price of silver, which reached 70¾c. recently and is not expected by most operators to fall much below 70c. A lead market of 8.65c., the best since last April, and zinc selling at 6.50c. contribute largely to the current activity. Copper miners likewise find 13.37c. for their metal, as compared with 12.62 a month ago, a decidedly welcome stimulant. Reports from Arizona show a tendency to increase output, but the larger producers probably will move in this direction only with deliberation.

Estimated Potential and Current Rates of Copper Output

	Approximate Capacity with Present Plant, Pounds	Estimated Current Rate of Output, Pounds
United States		
Anaconda	24,000,000	18,500,000
Arizona Commercial	900,000	700,000
Butte & Superior	1,200,000	1,200,000
Calumet & Arizona	4,300,000	3,800,000
Calumet & Hecla Con.	9,000,000	5,400,000
Chino	6,500,000	5,200,000
Copper Range	2,200,000	1,800,000
Ducktown	600,000	600,000
Engels	1,200,000	1,200,000
Isle Royale	1,200,000	750,000
Inspiration	8,000,000	7,500,000
Kennecott	4,000,000	2,000,000
Magma	3,200,000	3,200,000
Mammoth	1,600,000	1,600,000
Miami	6,000,000	6,000,000
Mohawk	1,600,000	1,600,000
Mother Lode	3,000,000	2,500,000
Nevada Con.	8,000,000	6,000,000
New Cornelia	7,500,000	5,000,000
Ohio	1,200,000	1,000,000
Old Dominion-Iron Cap	3,000,000	2,500,000
Phelps Dodge (U. S.)	18,000,000	12,300,000
Quincy	2,000,000	1,100,000
Ray	7,000,000	5,250,000
Tennessee	1,250,000	1,250,000
United Verde	10,000,000	9,000,000
United Verde Ex.	5,300,000	5,300,000
Delaware (Utah Con.)	1,000,000	400,000
Utah Copper	24,000,000	18,500,000
Walker	1,800,000	1,100,000
Totals	168,550,000	132,250,000
Foreign		
Braden	12,500,000	11,000,000
Boleo	1,500,000	1,400,000
Cerro de Pasco	12,000,000	4,200,000
Chile	20,000,000	16,000,000
Consolidated M. & S.	700,000	300,000
Falcon	450,000	450,000
Furukawa-Sumitomo	6,000,000	5,500,000
Granby	4,000,000	1,500,000
Greene-Cananea	3,500,000	2,500,000
Howe Sound	3,000,000	2,200,000
International-Mond Nickel	3,500,000	2,400,000
Katanga	20,000,000	18,000,000
Matahambre	2,000,000	1,900,000
Moctezuma	4,000,000	3,800,000
Mt. Lyell-Mt. Morgan	2,000,000	1,500,000
Totals	95,150,000	72,650,000

The accompanying table shows estimated current rates of output for the principal copper companies, both in the United States and abroad, together with a figure that approximates the output that each could achieve if conditions made maximum output desirable. These rates are based on present plant and equipment, the controlling factor in most cases probably being the concentrating, leaching, or smelting limitations rather than the capacity of the mine to supply more ore. An interesting comparison is the percentage of actual to potential production. Without considering the mines that now are not producing at all, this figure for the United States is about 78 per cent, whereas in the foreign countries it is only about 77 per cent, due largely to the drastic curtailment by Cerro de Pasco. Anaconda, Utah Copper, Phelps Dodge, and Calumet & Hecla, the four largest potential producers, stand out as leading the movement for curtailment in production in this country. Some of the smaller companies, on the other hand, are doing their best as to output. In Katanga, the Union Minière's potential production is hard to estimate, but more than 20,000,000 lb. was produced in August and every effort will be put forth to maintain this pace.

Several transactions indicate greater activity in California gold mining. The Empire Mines Co. has aquired new ground at Grass Valley, and is beginning development; the Idaho-Maryland Mines Co. has leased the Brunswick property; and W. J. Loring has assumed control of the Princeton property, where work will begin soon.

Despite an "apex" suit started by the Tonopah Extension against the West End company, at Tonopah, development and exploration feature Nevada's leading silver camp. The Tonopah Belmont has started work in Jim Butler and North Star ground and the Montana Tonopah has raised funds for developing the Gipsy Queen. Tonopah Extension produced $234,000 in September, a new high record.

All the lead smelters in Salt Lake district in Utah are working at a rate still higher than the high of recent months with heavy shipments from both Tintic and Park City. The latter district made a new high week's record in October. Tintic standard interests have consolidated the North Beck, Warrior, and Sacramento properties.

Arizona copper interests are optimistic. Development of the Verde Extension, Superior & Boston, and Kay Copper "prospects" is being pushed, with encouraging results. Inspiration's new porphyry shaft will start active production at once. The No. 6 mill of the Phelps Dodge Corporation, recently remodeled, is now running to capacity—6,000 tons daily. Officials of the company have definitely denied published rumors to the effect that the Phelps Dodge holdings were involved in negotiations for sale to another copper company.

Gold production at Cripple Creek, Colo., continues on a scale materially in excess of that of last year, with several new shippers. Reports of imminent shutdown of the Smuggler-Union, in the San Juan silver-lead-zinc region, have been officially denied, but the Atlas, for years the largest producer in Ouray County, has suspended operations. It is reported that the Sunnyside, owned by the United States S. R. & M. Co., has a minimum of three years' ore in sight at the present capacity. These mines supply the Durango smelter, the capacity of which has recently been increased. The National Lead Co. has leased and will operate the Fortune and Penfield properties at Leadville.

Idaho silver-lead mines, both in and out of the Coeur d'Alene, are active. Exploration of new ground by the Hercules and Federal companies above Wallace is important work. Some expansion of output on the part of the Anaconda company has benefited Butte.

Improving prices for zinc concentrate in the Joplin-Miami district led most operators, toward the end of October, to increase wages to the level provided in the sliding agreement for $45 "jack," although the base price for ore had not reached that point. Current production is between 14,500 and 15,000 tons weekly, thanks to policy of most operators to limit output so as to prevent flooding the market. Baxter Springs is the scene of much drilling.

In the Michigan Copper country, Ahmeek, with a record production of 2,600,000 lb., is the principal contributor to the C. & H. Con. output. The Calumet branch is still nonproductive as a consequence of the recent fire. A cut in rail freight rates on copper will help the companies.

The iron-ore season in the Lake Superior region virtually closed on Nov. 1, with shipments totaling about 42,000,000 tons compared with 60,000,000 during 1923.

The high price of silver has helped northern Ontario. Profits are better, lower-grade ores are being milled in some instances and development has been stimulated. The Tough-Oakes mill, at Kirkland, has been started, thereby increasing gold production. A new 250-ton mill will be built by the Crown Reserve, and the West Dome Lake has started production.

In Eastern British Columbia several lead-silver-zinc properties have been revived. Among them are the North Star, Stemwinder, and Ontario groups at Kimberley; the Bluebell, at Ainsworth; and the Emerald, at Salmo. The Premier has increased the capacity of its tramway to 350 tons per day.

Men You Should Know About

Phillip S. Hoyt

Phillip S. Hoyt has been selected as Oil and Gas Inspector of the State of Wyoming, following the reorganization of the State Department of Geology. Mr. Hoyt is one of the youngest public officials of Wyoming. He was born on June 5, 1896. He served in the Ninety-first Division, U. S. Army, during the Great War, and later worked as a tool pusher, field manager, and superintendent for the Burnside Oil Co. of Wyoming. Mr. Hoyt is the son of M. L. Hoyt, one of the pioneer oil men of Montana and Wyoming.

Nelson Dickerman, at the conclusion of a recent visit to New York, sailed on Oct. 30 for Chile.

Robert Brown has been appointed manager of the Wettlauffer property in Gowganda, Ontario.

Percy Cazalet, who has been connected with mining on the Rand for many years, has returned to the Cape, in South Africa.

Frank G. Stevens, of Toronto, has been in Arizona on mining business, and is now examining oil properties in Kentucky and Indiana.

H. A. Guess, vice-president of the American Smelting & Refining Co. in charge of mining operations, has gone to Mexico for a month.

George D. Dub has returned to New York from Cerro de Pasco, where he has been for two years, most of the time as mine superintendent.

Arthur Weigall, mining engineer, has accepted the managership of the Chosen property, in Korea. Mr. Weigall is considered to be an authority on mining conditions there.

Dr. John H. Banks, of John H. Banks & Son, consulting mining engineers, has returned to New York from an examination of copper properties in the Nacozari district of Sonora, Mexico.

D. S. Dean, of Boston, Mass., secretary of the Keweenaw Association, has been inspecting the mining properties on the Menominee and Gogebic ranges in Michigan of which the association owns the fee.

J. E. Spurr, on the invitation of the University of Toronto, gave three lectures on ore deposition at that institution on Oct. 29 and 30. Toronto members of the Canadian Institute of Mining Engineers were invited to the evening lecture delivered on the 29th. On the evening of Nov. 3 he addressed a joint meeting of the Section of the American Institute of Mining and Metallurgical Engineers and the Students' Affiliated Engineering Societies of Harvard, Massachusetts Institute of Technology and Tufts, at Memorial Hall, Cambridge, his subject being "The Evolution of Mining."

Obituary

Dr. Bruno V. Nordberg, founder of the Nordberg Manufacturing Co., died on Oct. 30. An appreciation of his career and achievements will appear in the Nov. 15 issue of *Mining Journal-Press.*

Harry A. Lee, formerly superintendent of the Silver King Consolidated mine at Park City, Utah, died at his home in Salt Lake City during the last days of October. Mr. Lee was sixty-five years old. He was born and educated in the Middle West and went to Utah in 1907. He resigned his position with the Silver King Consolidated two years ago to undertake private business.

David Alexander Dunlap, vice-president and treasurer of the Hollinger Consolidated Gold Mines, Ltd., and one of the pioneer mine operators of northern Ontario, died in Toronto on Oct. 29, after a long illness, at the age of sixty-one years. Mr. Dunlap was born in Pembroke, Ont., and practiced law for some years at Matawa. He went to Cobalt in the early days of the camp and in association with L. H. and N. A. Timmins and John D. McMartin acquired a controlling interest in the La Rose mine, in addition to engaging in other ventures. He and his associates took an early advantage of the opportunities offered by the Porcupine gold field, acquiring an interest in a large number of claims, chief of which were the four locations included in the original Hollinger mine and the adjacent Acme and Millerton properties, subsequently embraced in the Hollinger Consolidated. Mr. Dunlap was also vice-president of the Canadian Mining and Finance Co., which owns a number of mining properties in the Porcupine district as well as the controlling interest in the Hollinger. Though most widely known in connection with the mining industry he was a man of varied interests and keen public spirit. He was one of the founders of the Canadian Institute of Mental Hygiene; a Trustee of the Toronto General Hospital, the Toronto Art Gallery and Toronto Museum of Art, and prominent in connection with other social and benevolent organizations. He took an active interest in politics as a member of the Liberal Party and belonged to the Methodist Church. He is survived by his widow, one son and one daughter.

George Walker

Discoverer of the Witwatersrand

The honor of having discovered the greatest gold field in the world—the Witwatersrand—and the ill luck of having ended his days in comparative poverty—these are the dominant thoughts on receipt of the news of the death of George Walker, at Krugersdorp, Transvaal, South Africa, on Sept. 18. He was born in the neighborhood of a Lancashire coal mine, in which at fourteen he started work. At twenty-three years of age, in 1876, he decided to exchange the drabness of an English colliery town for what fortune had to offer in sunny South Africa. His first job was at Kimberley, washing blue ground for diamonds. After a brief apprenticeship, on wages, he grew dissatisfied and joined a mounted force known as Wetherley's Horse. Followed adventurous experiences and a return to the quest for gold, at Pilgrim's Rest and Spitzkop.

Great Britain had annexed the Transvaal in 1877. In 1880, Boer discontent led to revolt. Walker joined Henry Nourse's Horse, and was active in the field until an Anglo-Boer agreement was reached in 1881. He then returned to the diggings, operating at Spitzkop and Barberton, to which he had been one of the pioneer arrivals. Misfortune dogged him, however. At Spitzkop his claim was interdicted by a local company; at Barberton his work was stopped on a technical plea. Fate, it seemed, kept him on the move. Early in 1886 he was at Langlaagte. The discovery of the great reef was accidental: During a Sunday morning walk he tripped against a jutting rock that was hidden in the grass. The characteristics of banket ore were unknown to him, and he was puzzled at the appearance of a sample he chipped off, which, however, he took home for a pan assay. The indications of high gold content were unmistakable. He then approached the owner of the land on which he had made the discovery, with a view to obtaining an option to prospect. This, after much haggling, was granted, a sum equivalent to about $300 being agreed upon as due after three months, Walker then to have the option of buying the property, although no price seems to have been mentioned!

Walker's development work became increasingly promising, and definite discovery was made of the Witwatersrand main reef and also one of the leaders. Unfortunately for him, he lacked the small sum needed to satisfy the owner of the property before the stipulated time had expired; and, while away endeavoring to find a partner with the necessary funds, his discovery became known, and the sole reward for his pioneer work was two claims, one of which he gave to a friend and the second of which he sold for about £350.

He married Elizabeth Pretorius in Kroonstadt in 1883, and had nine children, all of whom are living. Recently he was present at the opening of a memorial park at Krugersdorp, to which he had donated a specimen of surface banket which he himself had mined, as a relic of pioneer initiative. His death, at seventy-one years of age, was the culmination of a long period of ill health.

Societies, Addresses, and Reports

A Novel Application of Glory Hole Mining

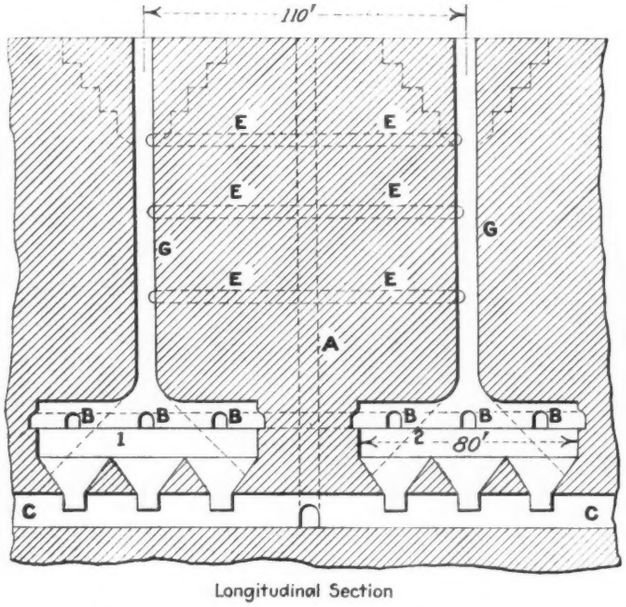
Described at Meeting of San Francisco Section of A.I.M.E. by R. A. Kinzie

AT THE October, 1924, meeting of the San Francisco Section of the American Institute of Mining & Metallurgical Engineers, R. A. Kinzie, chairman of the section, presented an impromptu description of the application of the glory-hole method of mining to a limestone deposit at Davenport, Calif. The deposit was mined by steam shovels and the bench system. Stripping of overburden is accomplished by the same method. The overburden, which is sandstone in part and in part shale, ranges from 50 to 100 ft. in thickness. The limestone deposit is trough shaped, about three-quarters of a mile long, 1,200 ft. wide, and of varying thickness. The limestone is used by the Santa Cruz Portland Cement Co. in the manufacture of cement.

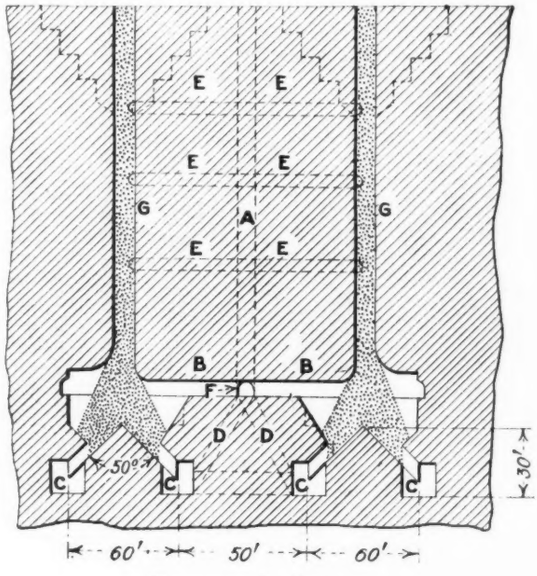
The lower end of the deposit was worked until the bench reached a height of 350 ft. At this point a change in methods took place. Mr. Kinzie devised a system of quarrying by means of glory holes. This involved novel arrangements that are of great interest. The general plan consists of main adit at 400 ft. elevation which intersects the center of the deposit. Drifts are turned off at an acute angle and are extended parallel with the main axis of the deposit.

The arrangement of the glory holes in groups of four is shown in the accompanying figure. *C, C, C, C* are drifts which are driven in pairs at 60 ft. intervals. A distance of 50 ft. separates the contiguous drifts of each pair. These drifts connect by chutes to four bulldozing chambers, 1, 2, 3, 4. In the center of each bulldozing chamber a vertical transfer raise, *G*, extends to the surface. The bulldozing chambers are 30 ft. above the floor of the drifts. Each is 80 ft. long and 60 ft. wide, and is served by six chute mouths. The bottom of the bulldozing chamber is sloped 50 deg. each way from the longer axis.

An intermediate drift, *F*, 30 ft. above the lower drifts, *C*, and connected to the lower drifts by inclined raises, *D, D*, extends through the center of the 50-ft. block between the drifts. Short crosscuts, *B, B*, extend to the bulldozing chamber opposite and above the chute raises. At the center of the square established by four bulldozing chambers a manway raise, *A*, extends to or near the surface. On the diagonals, *E, E, E, E*, of the square connections are driven to the transfer raises *G, G, G, G*, at 40 ft. vertical intervals. Their function is to give access to the main chutes at different points so as to enable stoppages to be remedied.

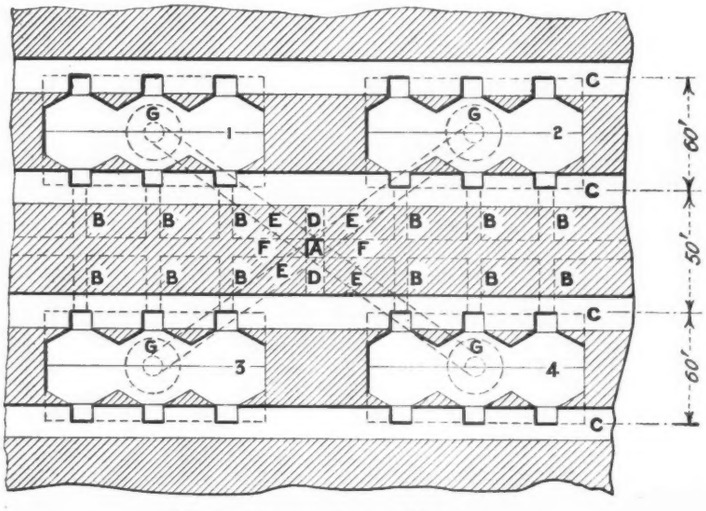


Longitudinal Section



Transverse Section

Sketches showing method of glory hole mining used in limestone deposit at Davenport, Calif.



Plan, Section in Plane of Chutes

In each bulldozing chamber a shelf is cut in the wall, to give access to the chamber on all sides. This connects with the crosscuts *B*. At the bottom of the transfer raise the broken limestone forms a cone (in section). The roof of the bulldozing chamber is coned out at the transfer raise. The arrangement provides safe access and good ventilation, and bulldozing can go on without regard to the drawing of ore from the chute mouths or without interference from the glory-hole operations. The large pieces float to the outer surface of the cone and can be block-holed and blasted conveniently.

No grizzly is used. The loading chutes are provided with arc gates of the Perseverance type. Chute mouths are 6 ft. 6 in. wide by 5 ft. high, and

pieces up to 4 x 5 x 3½ ft. can be passed through. To prevent gushing and overrunning of cars, hammers made of cast iron are suspended 1½ ft. in front of the openings, and these retard the flow of rock sufficiently to bring it under control. The front of the hammers is protected by pieces of wrought iron, which are so fastened as to leave a one-inch space between the casting and the side toward the chute. This expedient was found to prevent all breakages caused by bulldozing at the chute mouth, which is sometimes necessary.

The center drift, *F*, and crosscuts, *B*, are 5 x 6 ft. in section. The main transfer raises are 10 x 10 ft. in the clear and are raised in sections from the connecting passages *E*. The manway raise is 5 x 8 ft. in section and is driven as a raise. Chute raises are 6 x 8 ft. and are driven on an angle of 50 deg. The raise is provided with a staggered ladderway, the platforms being 14 ft. apart. Ladders are constructed of 4 x 4-in. side pieces and rungs are one-inch pipe. Main drifts are 9 x 12 ft. in section. One is provided with a 3 x 4-ft. drain ditch. The main drifts were driven by a pyramidal cut with thirty-two holes per round of six feet. The limestone drills easily. Holes are blasted in three groups and not all at once. The latter procedure was unsuccessful in the limestone.

The bedding of the limestone dips 15 deg., which is an advantage in breaking the benches at the glory holes. Jackhammers are used, and holes are 18 ft. in depth and are spaced 8 ft. apart. From twelve to twenty holes are blasted at once by means of electric blasting caps and machine. No. 1 special Herecules is used in the glory holes. In the underground work 40 per cent powder is used. Gelatin powder is used in the raises. Blasting in underground workings is done by the use of fuse. In the bulldozing chambers 40 per cent gelatin is used. A system of compressed-air whistles is used for warning men.

The powder ratio in the glory holes ranges from four to five tons per pound. Drifts cost $18 per foot, including explosives; intermediate drives and chute raises $6.50 per foot, and main raises $12 to $14 per foot. Underground work is done by contract. The tons per man per shaft ratio is 100, although on a longer interval the average would probably be eighty tons per machine drill shift for all work up to the transportation.

The cars are of the solid-bottom type holding fourteen tons but only loaded up to twelve tons. They are hauled underground by storage-battery locomotives. The tracks are 56-lb. steel rails on 36-in. gage. The trains of 240 tons each are hauled 3.5 miles by an eighteen-ton trolley-type locomotive to the revolving tipple at the crushing plant. Present output is 50,000 tons per month.

The compressed-air pipe system consists of 6-in. mains with 4-in. risers. The mains circle the pits and are connected back by return mains forming a closed circuit.

Three bulldozing chambers are now in use on clean limestone, and a fourth is on mixed limestone and clay. Raises are driven at a rate of 150 ft. per month. A 250-ft. raise requires about one and one-half month. From three to four months is required to bring a bulldozing chamber into operation. Explosives cost 4c. per ton. Breaking and delivery to cars at the chutes costs 11½c. per ton. The total cost, including delivery to the crushers, involving a four-mile haul, is 30c. per ton. These are operating costs over a three-months' interval.

Geological Society of America Will Meet at Ithaca

The thirty-seventh annual meeting of the Geological Society of America will be held Dec. 29-31, 1924, at Ithaca, N. Y., by invitation of Cornell University. The headquarters for registration and rooms will be in Prudence Risley Hall, Cornell University. The scientific session will be held in the Baker Laboratory of Chemistry and in McGraw Hall. Conversation, smoking and exhibition rooms will be provided in McGraw Hall.

Fellows have been urged to submit without delay the titles and abstracts of papers which they wish to present at the meeting, so that the program committee may be able to arrange to best advantage a program for the sessions.

The address of the retiring president, Waldemar Lindgren, will be delivered in the main lecture room, Baker Laboratory, Monday, Dec. 29, at 8 o'clock p.m.

By invitation of Cornell University the annual smoker will be held in the recreation room, Prudence Risley Hall, Dec. 29, at 9 o'clock p.m. The regular annual dinner of the Society will be held on Tuesday evening in Prudence Risley Hall.

Mine Executives to Lecture at University of Arizona

Through the efforts of Dean G. M. Butler, arrangements have been made for a series of lectures to engineering students of the University of Arizona, by twelve of the leading engineers, geologists and mine executives of Arizona during the coming term. Besides technical subjects, lectures will be delivered on such topics as "Mine Organization and Operation," "What I Should Do If I Were a Student Again," "Does Engineering Offer an Attractive Opportunity to Ambitious Young Men," "What Is Wrong with the Engineers," and others.

Mr. V. de Camp, general superintendent of the United Verde Copper Co. at Jerome, delivered the first lecture of the series, taking as his subject "Some Do's and Don'ts for Recent Engineering Graduates."

Bureau of Mine Investigating Metal Mine Explosives

Much valuable information is being developed by the U. S. Bureau of Mines in connection with the use of explosives in metal mines. Its investigations develop that certain explosives were productive of a large amount of carbon monoxide. As a result of cooperative work with one of the larger mining companies, a change of formula has been recommended which has been adopted by manufacturers. A type of explosive also has been developed which is not productive of large fragments in the metal mines stopes. This, together with new blasting methods which have been worked out in co-operation with the industry, promises to increase safety and to make blasting operations more efficient and economical.

Efforts are being made to convince metal mining companies generally that there frequently is room for improving blasting practice. These experiments have demonstrated the advantage of stemming, a practice now being used generally in Arizona mines.

These experiments also are dealing with the grade of explosive found most effective in ground of varying degrees of hardness; with the effect of density of loading, and the diameter, depth and position of holes in drift rounds. An investigation also is being made of the effect of the wrapper containing the explosive in the production of poison gas.

Report Says Mining Improving in Colorado and New Mexico

Metal mining in Colorado and New Mexico is improving both in production and in value, according to a special report received at the Department of the Interior. The report in part says:

Production of gold, silver, and perhaps lead during 1924 in Colorado will probably show an increase over 1923, which year had showed improvement over the previous lean years. At the present time silver is selling for about 72c. an ounce, as compared with a value of 64c. and less earlier in the year; lead is quoted at 8¼c. a pound, as compared with quotations earlier in the year ranging from 6c. to 7.8c., the substantial increase in the value of these metals stimulating mining activities and production. Prospects for a continued active demand for these metals are very encouraging.

The Cripple Creek and San Juan districts will probably produce more gold than in 1923. Leadville will show decreased metal production this year, but with unwatering of two deep mines there, now about completed, prospects are favorable for a good increase in production next year. Leadville has a vast amount of low-grade complex ores which are difficult to mine at a profit at the present time.

Prospecting in Colorado has been very active during the summer and has resulted in important discoveries near Idaho Springs, San Juan district, and Lake City.

The production of metals in New Mexico in 1924 will probably vary little from that of 1923; that year saw almost 100 per cent increase over 1922. Copper is now quoted at 13¼c. per pound and has ranged between 12⅞c. and 13c. during the most of the year. Until there is further increase in the price of copper marked increase in copper mining activity cannot be expected.

In 1923, Colorado produced a gross calculated recoverable value of metals of $18,471,590, including $6,591,629 in gold, 5,334,488 oz. of silver, over 45,000,000 lb. of lead, and 54,152,000 lb. of zinc. During the same year New Mexico produced metals to a value of $11,573,805, including over 61,000.000 lb. of copper and 16,000,000 lb. of zinc.

New Machinery and Inventions

This Hydraulic Press Combines Vertical and Horizontal Features

To meet a demand for a general-utility shop press, the Watson-Stillman Co., of New York, has combined in one unit a vertical press for forcing, bending, straightening, pressing and forming, and a horizontal press for all the operations which are ordinarily done on a press of this character.

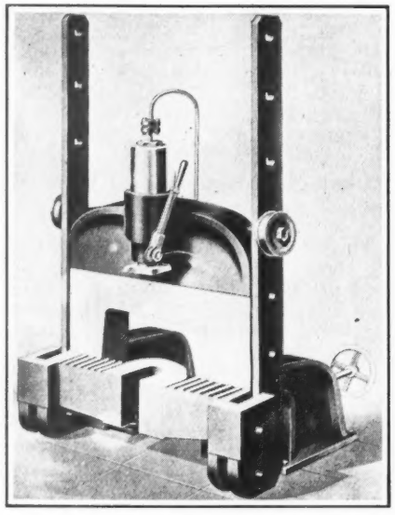
The press shown in the illustrations is a composite unit consisting of the following:

60-ton pipe bender
60-ton shaft straightener
60-ton die sinking and upsetting press
60-ton vertical forcing press
Small hand-power arbor press
7 ft. horizontal forcing press
60-ton horizontal forming and bending press.

The machine may be converted into a horizontal press by rotating a hand wheel shown in the illustration. The press is so balanced that the change from vertical to horizontal position may be made without the assistance of crane or jack. In the horizontal position it may be used for a variety of purposes, such as bending structural shapes, bending pipe, bars, force fitting, forcing on and off gears, disks and wheels and similar operations. The bed of the press is planed smooth and the forming tool on the end of the ram is supported on this bed.

For forcing long shafts the abutment beam may be moved out a maximum of 7 ft. A four-wheel truck is provided to permit easy handling and also to support the beam when extended.

Hydraulic pressure is used only for the high-pressure stroke of the ram. The idle part of the forward stroke and the return movement is affected by a pinion which meshes with a rack in the ram. This rack and pinion device is of sufficient power to make use of the press for light arbor work without hydraulic power.



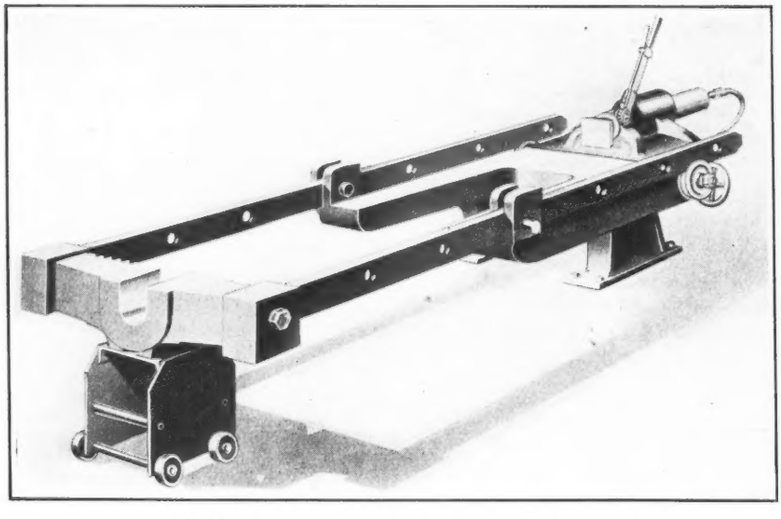
In position for vertical use

The press is so balanced that the change to horizontal position may be made without crane or jack

The press is usually furnished with a hand pump complete with hydraulic gage, pipe, and connections. It may also be operated by a small two-plunger power pump.

Fuller-Lehigh Makes Agreement

The Fuller-Lehigh Co., 50 Church St., New York, has entered into an agreement with Babcock & Wilcox, Ltd., of London, England, to operate under the Fuller-Lehigh Co. patents whereby everything in connection with its pulverized coal business will be handled in the various countries throughout the world by the Babcock & Wilcox, Ltd., of London, with the exception of the United States, its dependencies, and Canada and Mexico.



Hydraulic press ready for horizontal work

The machine is brought into this position by rotating the small handwheel shown. It may now be used for bending structural shapes, pipes and bars, for force fitting and similar operations

Trade Catalogs

Diesel Engines—One of the most informative catalogs, as well as one of the handsomest, received in some time, is that of the Busch-Sulzer Bros. Diesel Engine Co., of St. Louis, Mo. This is a 95-page well-illustrated book on Diesel engines. The Diesel principle is explained by text and diagrams, and much tabular matter and operating data of various kinds are contained in the catalog.

Resistor Units—Bulletin No. 48,941A, entitled "CR-9006 Enameled Resistor Units," has been issued by the General Electric Co. This is a well-illustrated booklet describing the uses and advantages of these units and giving standard ratings and dimensions. Applications are given for several different fields of service. The bulletin contains eighteen reading pages.

Crushers — The Traylor Engineering & Manufacturing Co., Allentown, Penn., has just issued a new profusely illustrated bulletin, No. 109 which describes the company's Bulldog finishing crusher. It is expected to be of interest to the sand and gravel industry, because in the past it was often the custom to discard the hard "nigger-heads" that accumulated. The crusher described is designed to withstand the heavy strains to which a breaker crushing this hard rock is subjected. It has the same features that characterize the larger type of Bulldog crusher—namely, the Hewes rigid bar type spider; positive force-feed lubrication; a split and tapered head nut which eliminates thread stripping; and a dust seal. In addition, without dismantling the crusher in any way and without the use of zinc or heavy lifts, six separate and distinct settings of the concaves can be made.

Electric Fuse—A device known as the Trico handy pocket-size fuse puller and replacer is described in a leaflet issued by the Trico Fuse Manufacturing Co., of Milwaukee, Wis.

Damper Regulators—The Atlas Valve Co., 282 South St., Newark, N. J., has issued Bulletin 5-A, devoted to its line of Victor damper regulators. The functions of damper regulators are fully listed under nine separate headings. Hydraulic operation as compared with other methods of operation is carefully treated. The uses of damper regulators in connection with all boiler pressures are covered in detail. Diagrams show how to apply the regulators to boilers.

Car Dumper. Bulletin No. 83, dated October, 1924, issued by the Wellman-Seaver-Morgan Co., Cleveland, Ohio, contains an eight page description of the W-S-M revolving car dumper. All sizes and capacities of open-top railway cars are handled by this machine. Whatever the size of car, the clamping arrangement automatically adjusts itself. It is only necessary to place the car in the machine and turn the control lever and the car is inverted. After dumping, the car is returned to its original position by simply turning the control lever in the opposite direction. Save for the revolving operation, all of the functions are entirely automatic.

The Market Report

Daily Prices of Metals

Oct. Nov.	Copper, N. Y. net refinery	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
30	13.275	52.375	52.875	8.65	8.40@8.775	6.50
31	13.275	52.625	53.125	8.65	8.40@8.70	6.50
1	13.25@13.375	53.50	54.00	8.65	8.40@8.70	6.55
3	13.375@13.50	53.00	53.50	8.65	8.40@8.725	6.575
4	.....	.....	.....	....	.....	.....
5	13.375@13.50	53.125	53.625	8.65	8.40@8.75	6.575
Av.	13.348	52.925	53.425	8.65	8.565	6.54

*These prices correspond to the following quotations for copper delivered: Oct. 30th and 31st, 13.525c.; Nov. 1st, 13.50@13.625c.; 3d and 5th, 13.625@13.75c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Oct. Nov.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
30	63 3/8	64 1/2	67 3/4	257 3/4	259 1/2	37 1/2	35 1/2	34 5/16	34 1/16
31	63 1/2	64 5/8	67 3/4	258 3/4	260 5/8	37 3/4	35 3/4	34 5/16	34 1/16
3	63 7/8	65	68	259 1/4	261	38	36 1/4	34 3/8	34 1/8
4	63 7/8	65	68 1/4	256 1/8	258 1/8	38 5/8	36 1/2	34 7/16	34 1/8
5	63 3/4	64 7/8	68	257 3/4	260 1/2	38 7/8	36 7/8	34 9/16	34 1/4

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Oct. Nov.	Sterling Exchange "Checks"	Silver		Gold London	Nov.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
30	4.51 7/8	70 1/8	34 15/16	91s 9d	3	4.54 1/8	69 1/2	34 3/8	91s 3d
31	4.51 3/4	69 3/4	34 3/4	91s 9d	4	.....	...	34 1/2	91s 1d
1	4.54	70	34 3/4	... ...	5	4.55	69 5/8	34 7/16	91s 2d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Average Metal Prices for October

Copper:	
New York Electrolytic	12.933
London Standard	62.641
London Electrolytic	66.620
Lead:	
New York	8.235
St. Louis	8.118
London	35.715
Silver:	
New York	70.827
London	35.387
Sterling Exchange	448.274
Zinc:	
St. Louis	6.324
London	33.514
Tin:	
99 per cent	50.038
Straits	50.538
London	248.543
Quicksilver	70.654
Antimony	11.519
Platinum:	
Refined	$118.000
Crude	112.423

Copper, Zinc, and Tin Continue Advance

New York, Nov. 5, 1924.—The Presidential election held yesterday has not had any untoward effect on the metal markets, which have been active all the week, both here and abroad. The re-election of President Coolidge has given general satisfaction to the sellers and buyers of metal alike, and increased prosperity is expected. Copper, zinc, antimony, and tin prices have all advanced since last week, and lead and silver have held steady at the levels recently quoted. The supply of lead continues less than the demand, with producers trying to hold back prices.

Forward Copper at a Premium

With copper going out in good volume, both at home and abroad, producers have continued reluctant sellers except at gradually advancing prices. A feature of the week has been the increased tendency to ask higher prices for deliveries more than two months forward, and also for points that take a comparatively high freight rate. Today, for example, copper for delivery to near-by points, and for November and December, has sold for 13⅝c., delivered; January shipment to Connecticut Valley points has easily commanded 13¾c., while copper for shipment to Buffalo and points west has commanded 13⅞c. These prices also obtained on Monday. The export market on the last three days has varied from 13.70 to 13.85c., c.i.f.

Brass companies continue to be actively in the market for copper to take care of their increasing bookings. This afternoon the American Brass Co. raised its prices on wire ¼c. a lb.

Lead Substantially Unchanged

The official contract price for lead set by the American Smelting & Refining Co. continues at 8.65c., New York. Conditions have changed little from last week. A small tonnage has sold in New York, for prompt delivery or to dealers, at 9c., but the sales around this level are insignificant compared with the business booked at the Smelting company's price. Offerings by producers are not yet equal to the demand from all sources, but no consumer is suffering for want of lead. One large producer in the Middle West continues to sell at 8.40c., St. Louis, but his supplies are somewhat limited. Others are selling as high as 8⅜c., and 9c. has been obtained in Chicago for substantial tonnages of corroding lead.

Zinc Passes 6½c. Level

Galvanizers have bought fair tonnages of zinc during the past week, and the export demand has pushed the price above 6½c., St. Louis, orders being booked at 6.575c. today. The outlook is extremely good, with Europe apparently finding continued supplies of American metal necessary. In New York, the prices continue at 35c. per 100 lb. above St. Louis levels. High-grade zinc continues at 8@8¼c. per lb. delivered.

Tin Demand Good

Buying of prompt Straits tin has continued on a satisfactory scale, with forward deliveries commanding about the same prices as nearby.

Silver Steady but Quiet

The silver market continues quiet, with fluctuations within narrow limits, although the tendency of London is to lower its price to offset the improvement in sterling exchange.

Mexican Dollars—Oct. 30th; 53⅝c.; 31st, 53¼c.; Nov. 1st, 53⅞c.; 3d, 53⅝c.; 4th, holiday; 5th, 53⅞c.

Foreign Exchanges Quiet

Closing cable quotations on Monday were substantially unchanged from our last report, francs being 5.2425c., and lire, $4.36c. Canadian dollars, par.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified.

Aluminum—99 per cent, 28c. per lb.; 98 per cent, 27c.

London, 98 per cent, £125 long ton.

Antimony—Per lb.:
Chinese brands, 12½c.
Cookson's "C" grade, 14½@14¾c.
Chinese needle, lump, nominal, 8½@9c.
Standard powdered needle, 200 mesh, 9@10c.
White oxide, Chinese, 99 per cent Sb_2O_3, 12@13c.

Bismuth—$1.85@$1.90 per lb. London, 7s. 6d.

Cadmium — 60c. per lb. London, 2s. 2d.@2s. 6d.

Cobalt—$2.50@$3 per lb. Discounts on contracts. Oxide, $2.10@$2.25. London, 10s. for metal; 9s. for black oxide.

Germanium Oxide—25 to 50 gm. lots, $10 per gm.

Iridium—$260@$270 per oz. Nominal.
Iridium alloyed with platinum, $280@$286.

Magnesium—Sticks, 1⅛ in., 99.9 per cent, 90c.@$1 per lb. London quotes 3s. 3d. for 99 per cent.

[1]**Molybdenum**—99 per cent, $12 per lb.

Monel Metal—32c. per lb.

Nickel—Ingot, 29c.; shot, 30c.; electrolytic, 33c. (99.75 per cent grade).

Osmiridium—Crude, $58.50 per oz.

Osmium—$100@$104 per troy oz.

Palladium—$83 per oz. Crude, $60 per oz. London, £19.

Platinum—Refined, $118 per oz.
Crude $111@$112.

Quicksilver—$69@$70 per 75-lb. flask. London £10¾.

Radium—$70 per mg. radium content.

Rhodium—$85@$90 per oz.

Ruthenium—$40@$45 per oz.

Selenium — Black powdered, amorphous, 99.5 per cent pure, $2.10 per lb.

Tantalum—Metal, $350 per kg.

Tellurium—$2 per lb.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $5 per lb.

Tungsten Metal—Powder, 97 to 98 per cent, 95c.@$1 per lb. contained tungsten.

[1]**Zirconium Metal**—98 per cent grade, per lb., $30.

Metallic Ores

Chrome Ore—Per ton, c.i.f. Atlantic ports:
Indian, $18.50@$19.50.
Rhodesian, $21.50.
New Caledonian, $24.
Market nominal.

[1]**Galena Radio Crystals**—Best quality (50 per cent of sized fragments good) 50c. per lb. in 500-lb. lots, f.o.b. Philadelphia.

Iron Ore—Prices for iron ore and magnetite for 1924 season were published Aug. 9.

Manganese Ore — 41@45c. per long ton unit, seaport, plus duty. Nominal. Chemical grades[1], powdered, coarse or fine, 82@87 per cent MnO_2, Brazilian, Caucasian, and Javanese, $75@$80 per ton in carloads.

Molybdenum Ore—70@75c. per lb., of MoS_2 for 85 per cent MoS_2 concentrates. Nominal.

Pyrite Radio Crystals—(Best quality) $1.50 per lb. in 500-lb. lots.

Tantalum Ore—Foreign, 30@50c. per lb. of Ta_2O_5 contained, c.i.f. New York, according to quality.

Tungsten Ore—Per unit, N. Y.:
High-grade wolframite, $8.75@$9.
High-grade scheelite, $9.
Ordinary grades, $8.50.
Market nominal.

Vanadium — Minimum 18 per cent V_2O_5, $1@$1.25 per lb. Nominal.

Zinc, Firm—Lead, Higher

Joplin, Mo. Nov. 1, 1924

Zinc Blende		Per-Ton
High		$45.15
Premium, basis 60 per cent zinc		46.00
Prime Western, 60 per cent zinc		44.00
Fines and slimes, 60 per cent zinc	43.00@	41.00
Average settling price, all		42.34
Lead Ore		
High		117.75
Basis 80 per cent lead		120.00
Average settling price, all		111.07

Shipments for the week: Blende, 14,370; lead, 2,139 tons. Value, all ores the week, $846,020.

At 4:30 this afternoon buyers were declining to offer more than $44 basis Prime Western, with a number of sellers as firmly declining to accept less than $45 basis. About two hundred tons of premium ore sold on $46 basis.

Lead was freely quoted all week $120 basis by all buyers, with some sellers declining to accept this offering.

Production of zinc ore dropped 1,500 tons, with the closing down of several large mills, not to be restarted until stocks held by the owners are disposed of.

No Platteville report had been received at the hour of going to press.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can only serve as a general guide as to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can only be ascertained by direct negotiation between buyer and seller.

[1]Price furnished by Foote Mineral Co., Philadelphia.

[1]**Amblygonite**—8@9 per cent lithium oxide, $50@$60 per ton, f.o.b. mines.

Asbestos:
Crude No. 1—$300@$400.
Crude No. 2—$150@$200.
Spinning fibers—$90@$125.
Magnesia and compressed sheet fibers—$50@$80.
Shingle stock—$45@$55.
Paper stock—$30@$40.
Cement stock—$15@$25.
Floats—$9@$12.
Sand—$6@$8.
All per short ton, f.o.b. mines, Quebec, tax and bags included.
No. 1 Rhodesian crude, $280; No. 2, $175 per short ton, c.i.f. New York.

Barytes—Crude—$8.50 per ton, Missouri mines, 90@98 per cent $BaSO_4$; $9 per ton, f.o.b. Georgia mines; $6@$8, at Baltimore.
Ground—Off color, $13 per ton, Baltimore; white, $17, Baltimore.
Water ground and floated, bleached, $23@$24, f.o.b. St. Louis.
Shipments are about normal.

Bauxite—American, f.o.b. shipping point per gross ton:
Crushed and dried, $5.50@$8.75.
Pulverized and dried, $14.
Calcined, crushed, $19@$20.
Foreign, per metric ton, c.i.f.:
French, 5 per cent SiO_2, $5@$7.
Dalmatian, low SiO_2, $5@$7.50.

Beryl—4½c. per lb. f.o.b. Connecticut points. Nominal.
$85 per ton, hand-sorted crystals, f.o.b. New York. Nominal.

Borax—Granulated and refined, crystals or powdered, in bags, carloads, 4¾c. per lb.; in bbls., 5c. Boric acid, 10½c.

[1]**Celestite**—90 per cent $SrSO_4$, finely powdered, $40 per ton in carload lots.

Chalk—F.o.b. New York, per lb.:
English, extra light, 5c.
Domestic, light, 4¼@4½c.
Domestic, heavy, 3½@3¾c.
In bulk, $5@$5.50 per ton.

China Clay (Kaolin)—F.o.b. Virginia mines, per short ton:
Crude No. 1, $7.
Crude No. 2, $5.50.
Washed, $8.
Powdered, $10@$20.
Powdered (Blue Ridge), $12@$15.
Imported English, f.o.b. American ports:
Lump, $11@$18.
Powdered, $45@$50.
1A grades, domestic, $16, f.o.b. mines.

Corundum — South African, $65 per ton, New York.

Diatomaceous Earth—Per short ton, f.o.b. plant, California:
Kiln-fired brick, $65.
Kiln-fired aggregate, ¼ in., $45.
Insulating powder, $30.
Natural aggregate, ¼ in., $20.
Air-floated powder, $40.
Business reported satisfactory.

Emery—Per lb., f.o.b. plant:
Greek Naxos, 6½c.
Turkish, 6½c.
Khasia, 5½c.
American, 3½@4c.
Market fair.

Feldspar—Per long ton, f.o.b. cars, *North Carolina:*
No. 1 pottery grade, $6.50@$7.50, depending upon quality.

No. 2 pottery grade, $4.50@$5, depending upon quality.
No. 1 soap grade, $6.75@$7.25.
Good market for best grade.
In *Connecticut*, per net ton, f.o.b. mines:
Pulverized, $17@$18.
Better demand than during summer.
In *New Hampshire*, per net ton, f.o.b. mines:
No. 1, not exceeding 10 per cent SiO_2, $7.50.
No. 2 pottery grade, $7.
Ground, $17@$20, f.o.b. mill.
Market fair.
In *New York*, per ton, f.o.b. cars:
No. 1, $8. Market dull.
In *Maine:*
No. 1 ground, $19. Market good.
In *Tennessee:*
Pottery grades, $15.30@$18.
Tile grades, $14@$16.
Enameling grades, $11@$16.
Crude, $7 for ordinary grades. As high as $7.25 offered for exceptional quality.
Spotty. Improved in some lines.
In *Canada:*
No. 1 crude, $7 per short ton.
No. 1 ground, 200 mesh, $25.

Fluorspar — F.o.b. Middle Western mines, per net ton:
Gravel, not less than 80 per cent CaF_2, and not over 5 per cent SiO_2, $17.50.
Gravel, not less than 85 per cent CaF_2 and not over 5 per cent SiO_2, $18.50.
Lump, not less than 85 per cent CaF_2, not over 5 per cent SiO_2, $18.50.
Ground, 93 to 98.5 per cent CaF_2 and not over 3 per cent SiO_2, $35 in bulk, $39 in bags or barrels.
Acid, ground, not less than 98½ per cent CaF_2 and not over 1 per cent SiO_2, $45 in bulk, $49 in packages.
Liquidating of surplus stocks has temporarily demoralized the market. Fluorspar selling for less than cost of production of larger mines.

Fuller's Earth—Per ton, f.o.b. Midway, Fla.:
16 to 30 mesh, $16.50.
16 to 60 mesh, $18.
30 to 60 mesh, $18.
60 to 100 mesh, $14.
Plus 100 mesh, $7.50.
Powdered, imported, duty paid, $23 @$25 per ton.

Garnet—Per short ton:
Spanish grades, $60, c.i.f. port of entry.
Domestic Adirondack, $85, f.o.b. shipping point.
Canadian, $70@$80, f.o.b. mines.

Gilsonite—Per ton, f.o.b. Colorado:
Jet asphaltum, $36.
Selects, $33.
Seconds (ordinary grades), $25.50.

Graphite—First quality, per lb.:
Ceylon lump, 5½@6c.
Ceylon chip, 4½@5c.
Ceylon dust, 3½@4c.
Crude amorphous, $15@$35 per ton.
Flake, No. 1 and No. 2 from New York, 25@30c.
Ordinary flake, 8@15c.
Little demand.

Gypsum—Per ton, depending upon source:
Crushed rock, $3@$4.50.
Ground, $3.50@$6.
Agricultural, $5@$7.
Calcined, $8@$16.

Ilmenite—Concentrates, 52 per cent TiO_2, 1½c. per lb., f.o.b. Virginia points. $40 per short ton, Florida mines.

Iron Oxide (See Ocher) — Ground, 95 per cent through 200 mesh, Standard Spanish red, $45 per ton.

Kaolin—See China Clay.

Lepidolite—$20@$30 per ton for ordinary grades.

Limestone—Depending upon source, f.o.b. shipping points; per ton:
Crushed, ½ in. and less, $1.10@$1.70.
Crushed, 3 in. and larger, 90c.@$1.50.
Agricultural, $1.50@$5.

Magnesite—Per ton, f.o.b. California mines:
Calcined lump, 85 per cent MgO, $35.
Calcined ground, 200 mesh, $42.50.
Dead burned, $29@$31, Washington.
Dead burned, $40@$42, Chester, Pa.
Caustic calcined, Grecian, $50@$51, c.i.f., New York.
Demand brisk along Pacific Coast.

Manjak—Barbados, in 1 to 5 ton lots:
Grade "A," 6c. per lb.
Grade "AC," 7c. per lb.
Grade "AA," fine, 8c. per lb.
Grade "C," fine and lump, 9c.
Grade "C," lump, 12c.

Mica—
North Carolina prices:
Scrap, $17@$20 per ton.
Sheet, per lb., No. 1 quality, clear:
Punch, 1¼ in., 7c.
1½ x 2 in., 16c. 3 x 4 in., $1.75.
2 x 2 in., 30c. 3 x 5 in., $2.35.
2 x 3 in., 75c. 4 x 6 in., $3.
3 x 3 in., $1.25. 6 x 8 in., $4.50.
Ground, 60 mesh, $65 per ton.
Ground, 80 mesh, $70.
Ground, 120 mesh, $120.
Ground, 140 mesh, $125.
Dry ground, roofing, $30.
Dry ground, 80 mesh, $35.
Dry ground, 100 mesh, $67.50.
Dry ground, 160 mesh, $70.00.
In *New Hampshire:*
Washer and disk, $320 per ton.
Scrap, $24 per ton.

[1]**Monazite**—Minimum 6 per cent ThO_2, 6@8c. per lb.

Ocher—"Yellow Peruvian," $25@$30 per ton, Georgia mines.

Ozocerite—Per lb. in bags, New York:
Black, 160 deg. melting point, 26@27c.
Green, 170 deg. melting point, 28@29c.

Phosphate — Per long ton, f.o.b., *Florida* export prices:
76@77 per cent, pebble, $5.75.
75 per cent, $5.50.
74@75 per cent, $5.25.
70 per cent, $3.50.
68 per cent, $3.
In *Tennessee*, per long ton:
78 per cent lump, $8.
75 per cent hand-mined lump, $6.75.
75 per cent washed lump, $6.75.
72 per cent washed run of mine, $5.75.
65 per cent ground 95 per cent through 100 mesh, $7 per short ton.
Ground rock for direct application, good; furnace rock, fair; fertilizer rock, little demand.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Potash—

	Bags	Bulk
Muriate of potash 80@85 per cent, basis 80 per cent	$34.55	$33.30
Sulphate of potash 90@95 per cent, basis 90 per cent	45.85	44.60
Sulphate of potash-magnesia 48@53 per cent, basis 48 per cent	26.35	25.10
Manure salt 30 per cent	19.03	17.33
Manure salt 20 per cent	12.55	10.55
Kainit 14 per cent	10.25	8.25
Kainit 12.4 per cent	9.75	7.75

Two thousand pounds net weight, c.i.f. Atlantic and Gulf ports. German weights, tares and analyses.

For prompt shipment:
5 per cent on minimum quantity of 50 short tons K_2O
6 per cent on minimum quantity of 100 short tons K_2O
7 per cent on minimum quantity of 300 short tons K_2O
10 per cent on minimum quantity of 500 short tons K_2O

The calculations are on total quantity of foreign potash salts imported during the present fertilizer year ending on April 30, 1925.

On all orders received prior to Oct. 1, 1924, for prompt shipment, a summer rebate of 5 per cent on net prices was allowed.

The above prices and discounts apply on all orders received since May 1, 1924. These prices were issued by the Potash Importing Corporation on Sept. 10 through H. J. Baker & Bro., 81 Fulton St., New York, and by the Société Commerciale des Potasses d'Alsace. They are the prices of the German-French combine and are generally expected by the trade to be increased somewhat before long.

Pumice Stone—Imported lump, 3@40c. per lb.
Powdered, in bbl., 3@5c.
Lumps, in bbl., 6@8c.

Pyrites—Tharsis, per long ton unit, c.i.f. U. S. ports:
Furnace size, 12c.
Lump, 11c.
Fines, through ½ in., 11½c.
Cinder from ore to remain property of buyers.
Market weak.

Quartz Rock Crystals — Colorless, clear and flawed, pieces ¼ to ½ lb. in weight, 40c. per lb. in ton lots.
For optical purposes, double above prices.

Rutile—F.o.b. Virginia points, per lb.:
Granular, 94@96 per cent TiO_2, 12@15c.
Pulverized, 100 mesh, 94@96 per cent, 17@30c.
93 per cent TiO_2, $200 per ton, Florida, delivered.

Silica—Water ground and floated, per ton, f.o.b. Illinois:
450 mesh, $31@$34.
350 mesh, $25@$28.
250 mesh, $23.
200 mesh, $20.
100 mesh, $8.
Glass sand, $2@$2.25 per ton; brick and molding sand, $2@$2.25.

Spodumene — $20@$30 per ton, depending upon lithium content. Nominal.

Sulphur—$16@$18 per ton for domestic, f.o.b. Texas and Louisiana mines; $18@$20 for export, f.a.s New York.

Talc—Per ton, in 50-lb. paper bags, *Vermont* mills, carloads:
Ground, 200 mesh, extra white, $10.50.
Ground, 180 mesh, medium white, $10.

Ground, 160 mesh, medium white, $9.50.

In *New York*, double air-floated, including containers:

200 mesh, $13.75.
325 mesh, $14.75.
100 mesh, $11, not air-floated.
Demand fair.

In *California*, $20@$30 per ton, ground.

In *Georgia*, powdered, per ton:

Gray or yellow, $7.50@$10.
Red or white, $10@$14.
Market good for powders.
White, $12@$15.
Grayish white, $8@$10.
Red, $12@$14.
Yellow, $8@$12.
Roofing, $7.50@$8.
Improved market.

Tripoli—Per short ton, burlap bags, paper liners, per minimum carload 30 tons, f.o.b. Missouri:

Once ground:
Rose and cream colored, $16@$25.
White, $18@$27.

Double ground:
Rose and cream, $17@$25.
White, $19@$30.

Air-float:
Rose and cream, $25@$30.
White, $35.
Market steady.

Zircon—Freight allowed east of Mississippi River:

99 per cent, 6c. per lb., f.o.b. Florida.
Powdered, 7c. per lb., f.o.b. Florida

Mineral Products

Arsenious Oxide (white arsenic)—6¾c. per lb. delivered. Demand slightly better. Mexican arsenic sold at 6½c. per lb. ex ship, New York.

Copper Sulphate—4.75c.@4.90c. per lb.

Sodium Nitrate—$2.40 per 100 lb., ex vessel Atlantic ports.

Sodium Sulphate—$16@$17 per ton, New York.

Zinc Oxide—Per lb. in bags:

Lead free, 7⅝c.
5 per cent lead sulphate, 6¾c.
10 to 35 per cent lead sulphate, 6⅝c.
French, red seal, 9⅝c.
French, green seal, 10⅝c.
French, white seal, 11⅞c.

Ferro-Alloys

[1]**Ferrocerium**—$7 per lb.

Ferrochrome—1 to 2 per cent carbon, 30c. per lb.; 4 to 6 per cent carbon, 10¾c. per lb.

Ferromanganese—Domestic and foreign, 78@82 per cent, $100 per gross ton. Spiegeleisen, 19@21 per cent, $31, f.o.b. furnace; 16@19 per cent, $30.

Ferromolybdenum—$1.80 per lb. of contained molybdenum for 50 to 55 per cent grades.

Ferrosilicon—10 to 12 per cent, $39.50 @$43.50 per gross ton, f.o.b. works; 50 per cent, $72@$75 delivered.

Ferrotitanium—For 15 to 18 per cent material, $200 per ton, f.o.b. Niagara Falls, N. Y.

Ferrotungsten — 88@90c. per lb. of contained W, f.o.b. works. Quiet.

[1]**Ferro-uranium**—35 to 40 per cent U, $4.50 per lb. of U contained, f.o.b. works.

Ferrovanadium—$3.50@$4 per lb of V contained, f.o.b. works.

Metal Products

Rolled Copper—Sheets, 20⅞c.; wire, 15⅞c.

Lead Sheets—Full lead sheets, 12c. per lb.; cut lead sheets, 12½c. in quantity, mill lots.

Nickel Silver—27½c. per lb. for 18 per cent nickel Grade A sheets.

Yellow Metal — Dimension sheets, 18⅝c. per lb.; rods, 15⅝c. per lb.

Zinc Sheets—10.25c. per lb., f.o.b. works.

Refractories

Bauxite Brick—$140@$145 per M., Pittsburgh, Pa.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Chrome Brick—$45@$47 per net ton, f.o.b. shipping point.

Firebrick—First quality, $40@$43 per M., Ohio, Kentucky, Central Pennsylvania; second quality, $33@$37.

Magnesite Brick — 9-in. straights, $65@$68 per net ton, f.o.b. works.

Magnesite Cement—$47@$50 per net ton, f.o.b. Chester, Pa.

Silica Brick—$33@$35 per M. Pennsylvania; $48@$50 Alabama.

Zirkite—Powdered, 80 per cent ZrO_2, 5c. per lb.; 70 per cent, 2½c. per lb. Brick, straights, 75@95c. each.

The Iron Trade Still Dull

Pittsburgh, Nov. 4, 1924

The steel-making industry has been much impressed by the earnings statement of the Steel Corporation issued a week ago, following several poor earnings statements by independents. The particular point about the Steel Corporation statement was that earnings were scarcely as large in September as in July, whereas shipments were much heavier. Realized prices were much lower, and since September the setting up of district bases, in connection with abolition of "Pittsburgh plus" makes receipts still lighter. As a result there will be a stronger effort to secure better steel prices, and it is possible that some lines will advance slightly.

Pig Iron—Appearance of the Snyder basic iron average for October at $18.50, Valley, disclosed the fact that some Valley furnaces had sold at this figure, matching the sales already reported by sellers elsewhere at $18.50, Valley equivalent, and basic is now quotable at $18.50, f.o.b. Valley furnaces, bessemer remaining at $20, and foundry at $19.50. The market has continued quiet.

Connellsville Coke—Market dull with prices unchanged. Spot furnace, $3@$3.10; foundry, $4@$4.50; heating and smelter, $2.75@$3, according to quality and tonnage.

Company Reports

Shattuck Arizona Copper Co.

A report of the operations of the Shattuck Arizona Copper Co. for the quarter ended Sept. 30, 1924, states that copper ore was mined at about the same rate as in the previous quarter—approximately sixty tons per working day. Lead ore was mined at the rate of 100 tons per day. Considerable repairing and the reopening of some of the old stopes was done during the quarter. The company expected to increase the shipments of lead ore in October to 150 tons per day, for a short period at least. An increase in the shipments of copper ore will depend upon the increase in price of copper metal.

The production and costs per pound for the third quarter are as follows:

	Copper	Lead
Dry tons mined	4,614.05	9,155.00
Dry tons treated	4,834.71	9,062.65
Pounds metal recovered	608,885	1,302,319
Ounces silver recovered	14,688	71,282
Ounces gold recovered	146.01	888.94
Net operating cost per pound, cents	11.53	6.47

The net operating cost is for delivered metal after credit for precious metal byproducts, but before charge for depletion and deferred development expense.

The results in earnings for the quarter are as follows:

Refined copper at 13c. per pound		$79,155.05
Gold and silver (copper ore)		12,670.18
Gross value of lead ores		162,448.23
Gross value of siliceous ores		198.41
Interest		8,329.39
Dividends		170.00
		$262,971.26
Operating expense, copper	$82,597.99	
Operating expense, lead	150,212.33	
Operating expense, siliceous ores	493.45	
Administrative expense	6,257.62	239,561.39
Net income before depletion and deferred development charges		$23,409.87

The earnings on lead are for actual smelter settlements. The earnings on copper are obtained by inventorying copper at 13c. per pound, silver at 60c. and gold at $20 per ounce.

New Jersey Zinc Co.

A statement of the New Jersey Zinc Co. for the quarter ended Sept. 30, 1924, follows:

Income (including dividends from subsidiary companies) after deductions for expenses, taxes, maintenance, repairs, depreciation, depletion and contingencies	$1,095,006.31
Interest on first-mortgage bonds	40,000.00
Net income	$1,055,006.31
Dividend 2 per cent payable Nov. 10, 1924	981,632.00
Surplus for the quarter	$73,374.31

Note—Extra dividend of 2 per cent payable Oct. 10, 1924, was declared from surplus accumulated in the current year.

Metal Statistics

Monthly Average Prices of Metals

Silver

	New York		London		Sterling Exchange	
	1923	1924	1923	1924	1923	1924
January	65.668	63.447	31.928	33.549	465.053	425.524
February	64.313	64.359	30.875	33.565	468.631	430.457
March	67.556	63.957	32.310	33.483	469.269	428.769
April	66.855	64.139	32.346	33.065	465.220	434.788
May	67.043	65 524	32.611	33.870	462.252	435 716
June	64.861	66.690	31.611	34.758	461.132	431.675
July	63.015	67.159	30.942	34.509	458.025	436.649
August	62.793	68.519	30.952	34.213	455.714	449.510
September	64.203	69.350	31.698	34.832	453.901	445.740
October	63.649	70.827	31.718	35.387	452.024	448.274
November	63.818	.....	32.774	.....	437.839	.....
December	64.705	.....	33.375	.....	435.500	.....
Year	64.873	.....	31.929	.....	457.047	.....

New York quotations, cents per ounce troy, 999 fine, foreign silver. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York		London			
	Electrolytic		Standard		Electrolytic	
	1923	1924	1923	1924	1923	1924
January	14.510	12.401	64.494	61.273	71.409	67.193
February	15.355	12.708	67.700	63.113	74.500	68.167
March	16.832	13.515	73.851	66.137	81.464	72.087
April	16.663	13.206	73.169	64.338	81.331	70.150
May	15.440	12.772	67.460	62.006	76.568	67.648
June	14.663	12.327	66.607	61.375	73.238	66.313
July	14.321	12.390	65.278	61.652	72.364	65.815
August	13.822	13.221	64.034	63.481	70.000	67.800
September	13.323	12.917	63.194	62.750	68.275	67.125
October	12.574	12.933	60.614	62.641	64.250	66.620
November	12.727	.....	61.648	.....	66.477	.....
December	12.823	.....	62.035	.....	67.611	.....
Year	14.421	.....	65.840	.....	72.291	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London	
	1923	1924	1923	1924	1923	1924
January	7.633	7.972	7.571	8.002	27.119	31.528
February	8.050	8.554	8.093	8.643	28.519	34.589
March	8.252	9.013	8.254	8.891	28.815	37.161
April	8.101	8.263	7.996	7.932	26.956	32.819
May	7.306	7.269	7.085	6.973	25.614	29.426
June	7.146	7.020	6.852	6.848	25.429	32.138
July	6.237	7.117	6.126	6.886	24.188	32.916
August	6.582	7.827	6.496	7.764	24.222	32 744
September	6.856	8.00	6.700	7.876	25.688	33.023
October	6.831	8.235	6.570	8.118	27.815	35.715
November	6.846	.....	6.582	.....	30.352	.....
December	7.369	.....	7.369	.....	31.042	.....
	7.267	.....	7.141	.....	27.147	.....

New York and St. Louis quotations, cents per lb. London, pounds sterling per long ton.

Tin

	New York				London	
	99%		Straits			
	1923	1924	1923	1924	1923	1924
January	37.986	48.250	39.173	48.750	181.852	246.790
February	40.693	52.772	42.011	53.272	190.513	272.399
March	46.569	54.370	48.569	54.870	219.607	277.429
April	44.280	49.457	45.810	49.957	213.081	250.863
May	42.346	43.611	43.135	44.111	203.097	218.511
June	40.375	42.265	40.957	42.765	191.798	219.219
July	37.970	45.750	38.490	46.250	181.188	233.332
August	38.841	51.409	39.269	51.909	186.705	254.638
September	41.047	48.595	41.547	49.095	198.263	243.511
October	41.322	50.038	41.851	50.538	203.957	248.543
November	43.495	.....	43.995	.....	220.710	.....
December	46.662	.....	47.160	.....	235.007	.....
Year	41.799	.....	42.664	.....	202.148	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Zinc

	St. Louis		London	
	1923	1924	1923	1924
January	6.815	6.426	35.733	34.761
February	7.152	6.756	35.613	36.518
March	7.706	6.488	36.720	35.298
April	7.197	6.121	34.275	32.588
May	6.625	5.793	31.057	30.648
June	6.031	5.792	29.548	31.788
July	6.089	5.898	29.335	32.193
August	6.325	6.175	32.386	32.544
September	6.438	6.181	33.469	32.926
October	6.293	6.324	32.995	33.514
November	6.347	.....	32.949	.....
December	6.260	.....	32.611	.....
Year	6.607	.....	33.058	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a)		Quicksilver (b)		Platinum (c)		
	New York		New York		Refined New York		Crude
	1923	1924	1923	1924	1923	1924	1924
January	6.884	10.279	72.731	59.500	112.462	122.115	115.500
February	7.290	10.935	70.636	59.565	113.273	124.739	115.935
March	8.885	11.442	70.808	64.269	110.846	121.692	113.231
April	8.380	9.952	69.200	74.308	116.840	115.577	108.077
May	7.477	8.755	68.000	76.962	115.007	115.731	112.192
June	6.839	8.403	67.769	73.720	115.615	116.000	113.000
July	7.097	8.477	66.980	72.173	116.000	118.231	113.865
August	7.753	9.839	65.212	72.096	116.000	120.000	113.500
September	7.633	11.022	63.000	72.423	116.000	118.923	113.058
October	8.005	11.519	61.769	70.654	116.923	118.000	112.423
November	9.156	.....	61.917	.....	124.479	.....	.....
December	9.365	.....	60.000	.....	125.000	.....	.....
Year	7.897	.....	66.502	.....	116.537	.....	.....

(a) Antimony quotations in cents per lb. for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1923	1924	1923	1924	1923	1924
January	29.27	24.76	27.35	23.76	28.77	23.88
February	29.79	25.26	28.15	23.76	27.21	25.06
March	32.03	25.14	31.79	23.76	31.77	24.76
April	32.77	24.56	32.77	23.26	32.77	23.80
May	31.87	23.89	29.83	22.08	32.46	22.91
June	30.27	22.90	28.34	21.49	29.81	21.43
July	28.47	21.90	26.52	20.76	27.47	20.76
August	28.27	21.76	26.77	20.76	26.77	20.99
September	28.26	21.76	26.26	20.76	26.72	21.68
October	26.96	21.76	25.01	20.26	25.52	21.26
November	24.79	.....	22.57	.....	23.60	.....
December	24.54	.....	22.62	.....	23.72	.....
Year	28.94	.....	27.33	.....	28.05	.....

In dollars per long ton.

Monthly Crude Copper Production

Domestic

	1924			
	June	July	August	September
Alaska shipments	6,314,241	9,949,406	138,760	3,602,468
Calumet & Arizona	2,346,000	2,732,000	3,802,000	3,448,000
Miami	5,439,000	4,806,000	5,108,000	4,099,000
New Cornelia	4,651,589	4,427,373	5,627,261	5,096,158
Old Dominion	1,715,000	2,321,000	2,455,000	2,495,000
Phelps Dodge	10,925,000	12,248,000	12,341,000	11,958,000
United Verde Extension	3,579,448	3,474,178	4,011,746	5,268,896
A.S. & R. & Tenn. Copper	17,000,000	18,500,000	12,000,000	14,750,000
Imports: Ore and concentrates, matte	13,796,247	10,037,156	12,354,191	11,759,019
Partly from				
Chile	6,874,522	3,514,581	3,687,191	5,939,411
Cuba	.....	2,537,920	2,685,000	2,560,000
Canada	4,043,342	282,689	2,073,966	319,724
Mexico	1,798,738	2,084,239	2,128,722	1,800,113
Imports of black and blister, unrefined	52,698,756	36,245,999	29,215,759	27,024,684
Partly from				
Chile	13,616,153	12,405,405	4,097,634	8,022,886
Peru	8,973,871	5,427,330	6,936,387	3,824,548
Africa	16,680,456	8,512,932	8,536,719	6,141,793
Mexico	7,802,748	3,599,039	3,843,264	4,512,257
Imports of refined and old	14,595,751	17,102,388	16,647,115	15,216,096

Foreign

Boleo, Mexico	1,375,201	1,314,275	1,258,030	1,433,148
Falcon Mines, Rhodesia	468,000	466,000	474,000	479,200
Furukawa, Japan	2,370,647	2,601,374	2,594,205	.....
Cons. M & S., Canada	590,000	674,000	416,865	270,380
Granby Cons., Canada	3,076,770	3,120,904	2,238,146	1,508,786
Katanga, Africa	15,807,643	18,861,570	20,411,685	17,293,815
Mount Morgan, Aust	894,000	916,000	.....	.....
Mount Lyell, Aust	668,000	750,000	786,000	.....
Phelps Dodge Mexican	2,783,000	4,002,000	3,292,000	3,792,000
Sumitomo, Japan	2,797,577	3,004,986	2,519,542	3,350,001

Comparative U. S. Copper Mine Production

	1921	1922	1923	1924
January	90,596,597	32,010,292	112,267,000	133,356,000
February	86,682,941	45,957,530	102,725,000	128,260,000
March	91,046,345	55,705,760	121,562,000	129,816,000
April	46,946,523	76,601,000	118,157,000	131,928,000
May	25,310,511	88,714,000	125,438,000	130,644,000
June	24,623,693	93,740,000	125,479,000	127,506,000
July	22,033,739	91,000,00	125,249,000	129,574,000
August	23,248,398	101,188,000	131,088,000	133,512,000
September	23,855,316	96,408,000	124,523,000	127,346,000
October	23,231,572	103,273,000	132,481,000	.....
November	28,341,442	102,845,000	127,963,000	.....
December	26,629,137	103,003,000	129,354,000	.....

(a) Not available.

Mining Stocks

Week Ended November 1, 1924

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Alaska-Br. Col.	N. Y. Curb	*10	*10	*10		
Anaconda	New York	37⅛	36½	36¾	De.15, Ja.21, Q	0.75
Arcadian Consol.	Boston	1⅞	1⅝	1⅞		
Ariz. Com'l	Boston	10⅝	9⅞	10¼	Jy.19, Jy.31	0.50
Calaveras	N. Y. Curb			2		
Calumet & Arizona	Boston	51	49½	50	Se. 5, Se. 22 Q	0.50
Calumet & Hecla	Boston	15⅜	14⅞	15⅛	My. 31, Jn. 16	0.50
Canario Copper	N. Y. Curb	4	3⅞	4		
Cerro de Pasco	New York	46⅞	45⅞	46⅝	Oc. 23, No. 1	1.00
Chile Copper	New York	32⅜	31⅞	32⅛	De.3, De.29, Q	0.62½
Chino	New York	21⅛	20	21⅛	Sept., 1920	0.37½
Con. Coppermines	N. Y. Curb	3 3/16	2 7/16	3		
Copper Range	Boston	24⅛	22	23⅜	May, 1923	1.00
Crystal Copper	Boston Curb	*53	*45	*51		
Davis-Daly	Boston			*35	Mar., 1920	0.25
East Butte	Boston	4⅛	4	4⅛	Dec., 1919	0.50
First National	Boston Curb			*36	Feb., 1919	0.15
Franklin	Boston	*75	*60	*75		
Gadsden Copper	Boston Curb	*64	*61	*64		
Granby Consol.	New York	18⅛	17⅝	17⅝	May, 1919	1.25
Greene-Cananea	New York	15⅛	14⅞	15⅛	Nov., 1920	0.50
Hancock	Boston	*75	*30	*75		
Howe Sound	N. Y. Curb	2⅜	2	2⅛	Ap.1,Ap.15, Q	0.05
Inspiration Consl.	New York	25⅛	24	24⅞	De.20, Ja.7, Q	0.50
Iron Cap	Boston Curb	2	2	2	May, 1923	0.15
Isle Royale	Boston	15⅜	14⅞	15¼	Se. 1, Se. 15	0.50
Jerome Verde Dev.	N. Y. Curb	*95	*95	*95		
Jib Consol.	N. Y. Curb	*48	*35	*43		
Kennecott	New York	47⅛	46⅛	47⅛	Se.5, Oc.1, Q	0.75
Keweenaw	Boston			*65		
Lake Copper	Boston	2	1⅞	1⅞		
Magma Copper	New York	35	34	35	Jan., 1919	0.50
Mason Valley	N. Y. Curb	1⅜	1⅜	1⅜		
Mass Consolidated	Boston	1	1	1	Nov., 1917	1.00
Miami Copper	New York	22⅜	21⅜	21⅞	No.1 No.15 Q	0.50
Mohawk	Boston	32⅜	31	32⅛	Se. 22, Oc. 13	1.00
Mother Lode Coa.	New York	7⅞	7½	7½	Jn. 13, Jn. 30	0.37½
Nevada Consol.	New York	13⅞	13⅜	13⅞	Sept., 1920	0.25
New Cornelia	Boston	20	19	20⅜	No. 7, No. 24	0.25
New Dominion	N. Y. Curb			2⅞		
North Butte	Boston	3	2⅞	2⅞	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	1 3/16	1 1/16	1⅛	No.14, De. 2	0.05
Old Dominion	Boston	21	21	21	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†113	†109		Se.20, Oc.1 Q	1.00
Quincy	Boston	21⅛	20	20	Mar., 1920	1.00
Ray Consolidated	New York	13⅛	11⅞	13	Dec., 1920	0.25
Ray Hercules	N. Y. Curb			*15		
St. Mary's Min. Ld.	Boston	33⅜	32⅛	33⅛	Ap.22, My.20	3.00
Seneca Copper	New York	1⅛	1	1⅛		
Shannon	Boston	*80	*80	*80	Nov., 1917	0.25
Shattuck Arizona	New York	7	6⅞	7	Jan., 1920	0.25
Superior & Boston	Boston	1 1/16	1⅛	1 1/16		
Tenn. C. & C. cfs	New York	8	7⅞	7⅞	De.31, Ja.15,Q	0.25
United Verde Ex.	N. Y. Curb	26	26	26	Oc. 3, No. 1	0.50
Utah Copper	New York	81⅞	80⅝	80⅞	Se.15, Se.30,Q	1.00
Utah Metal & T.	Boston	*30	*23	*23	Dec., 1917	0.30
Victoria	Boston	*70	*55	*70		
Walker Mining	N. Y. Curb	2 1/16	2 1/16	2 1/16		
Winona	Boston	*40	*20	*25		
NICKEL-COPPER						
Internat. Nickel	New York	19⅞	19	19⅜	Jy.17, Au.1, Q	1.50
Internat. Nickel pfd.	New York	92½	92½	92½	Oc.16, No.1, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	3⅜	3	3		
National Lead	New York	154⅜	151¾	154⅛	Se.12, Se.30, Q	2.00
National Lead pfd.	New York	116¼	116	116	No.21,De.15, Q	1.75
St. Joseph Lead	New York	35½	33⅜	35	De. 9, De. 20	0.50
ZINC						
Am. Z. L. & S.	New York	8⅜	8	8⅜	May, 1920	1.00
Am. Z. L. & S. pfd.	New York	29½	27	29	Nov., 1920	1.50
Butte C. & Z.	New York	5⅜	5	5⅛	Mar., 1923	0.50
Butte & Superior	New York	17	16	16	Je.15, Je.30, Q	0.50
Callahan Zn-Ld.	New York	3⅜	3⅛	3⅛	Dec., 1920	0.50
New Jersey Zn.	N. Y. Curb	163	163	163	Oc.,No.,'24 QX	4.00
United Zinc	N. Y. Curb			*25		
Yellow Pine	Los Angeles		67½		June, 1924	0.04
SILVER						
Alvarado	N. Y. Curb			1½		
Beaver Consol.	Toronto	*18	*17	*17½	May, 1920	0.03
Castle-Trethewey	Toronto	*73	*71	*71½		
Coniagas	Toronto	2.10	2.04	2.05	Ap.20, My.1	0.02½
Crown Reserve	Toronto	*53	*50	*52½	Jan., 1917	0.05
Keeley	Toronto	2.30	2.27	2.28	Sept. 15, SA	0.12
Kerr Lake	N. Y. Curb	1⅝	1⅝	1⅝	Oc. 1, Oc. 15,	0.12½
La Rose	Toronto	*8	*5⅜	*5½	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto	1.45	1.45	1.45		
McKinley-Dar.-Sav.	Toronto	*12	*11¼	*11½	Oct., 1920	0.03
Mining Corp. Can.	Toronto	2.75	2.65	2.71	Sept., 1919	0.12½
Nipissing	N. Y. Curb	6	6	6	Oc.1,Oc.20,QX	0.30
Ontario Silver	New York	7	7	7	Jan., 1919	0.50
Temiskaming	Toronto	*20	*20	*20	Jan., 1920	0.40
GOLD						
Alaska Gold	New York	*12⅛	*12⅛	*12⅛		
Alaska Juneau	New York	1	1	1		
Argonaut	Toronto	*30½	*27½	*29½		
Carson Hill	Boston	1	*75	*99		
Cresson Consol. G.	N. Y. Curb	3⅜	3 3/16	3⅛	Se.30, Oc.6 Q	0.10
Dome Mines	New York	15	14⅛	15	Oc.3, Oc.20, Q	0.50
Golden Cycle	Colo. Springs	1.30	1.30	1.30	My.31, Jn.10 Q	0.03
Hollinger Consol.	Toronto	14.35	13.85	14.30	Oc.16, No.3, M	0.05
Homestake Mining	New York	44½	44½	44½	Oc.20,Oc.25,M	0.50
Kirkland Lake	Toronto	*19	*18⅝	*18⅞		
Lake Shore	Toronto	3.90	3.88	3.89	Se.1, Se.15, Q	0.05
McIntyre-Porcupine	New York	15½	15⅛	15½	No. 1, De. 1	0.25
Newray	Toronto	*31	*27	*28		
Portland	Colo. Springs	45	45	45	Oct., 1920	0.01
Teck-Hughes	Toronto	1.17	1.13	1.16		
Tom Reed	Los Angeles			23½	Dec., 1919	0.02
Tough-Oakes	Toronto	*50	*47	*48½		
United Eastern	N. Y. Curb			*37	Jy.18, Jy.31, Q	0.05
Vipond Cons.	Toronto	1.25	1.23	1.24		
Wright-Hargreaves	Toronto	3.75	3.75	3.75	Se.15,Oc.1, Q	0.02½
GOLD AND SILVER						
Black Oak	N. Y. Curb			*89		
Con. Cortez	N. Y. Curb	*13	*12	*13		
Con. Virginia	San Francisco			4⅛		
Continental Mines	N. Y. Curb			2¼		
Dolores Esperanza	N. Y. Curb			*32	Jy.1, Jy.10 Q	0.05
Premier Gold	N. Y. Curb	2 5/16	2⅛	2⅛	Se. 25, Oc. 30	0.08
Tonopah Belmont	N. Y. Curb	*60	*52	*60	Apr., 1923	0.05
Tonopah Divide	N. Y. Curb			*21	Se. 22, Oc. 10	0.10
Tonopah Extension	N. Y. Curb	3 1/16	3⅛	3 1/16	Se. 10, Oc. 1	0.05
Tonopah Mining	N. Y. Curb	2	1 15/16	2	Se. 30, Oc. 21	0.07½
Unity Gold	N. Y. Curb	1	1	1		
West End Consol.	N. Y. Curb	*52	*52	*52	Mar., 1923	0.05
Yukon Gold	N. Y. Curb			*50	June, 1918	0.02
SILVER-LEAD						
Ahumada	Boston Curb	7	6⅞	6⅞	Se.16, Oc.2, X	0.15
Bingham Mines	Boston			15⅜	Sept., 1919	0.25
Cardiff M. & M.	Salt Lake	*80	*80	*80	Oct., 1924	0.10
Chief Consol.	Boston Curb	2⅜	2⅝	2⅜	Ap.19, My.1,Q	0.10
Columbus Rexall	Salt Lake	24	24	24	Aug., 1920	0.03
Consol. M. & S.	Montreal	47⅛	43¼	47¼	Jn.30, Jy.15	0.75
Daly Mining	Salt Lake			2.00	July, 1920	0.10
Erupcion	Boston Curb			2½	Se. 15, Oc. 2, X	0.15
Federal M. & S.	New York	12	12	12	Jan., 1909	1.50
Federal M. & S. pfd.	New York	53	45¼	52½	Au.25, Se.15,Q	1.75
Florence Silver	Spokane	6	4⅜	4⅜	Apr., 1919, QX	0.01
Hecla Mining	N. Y. Curb	9⅜	9	9⅛	Sept. 15, 1924	0.25
Iron Blossom Con.	N. Y. Curb			*25	Oc.25, 1924	0.02½
Marsh Mines	N. Y. Curb			*5	June, 1921	0.02½
Park City	Salt Lake	4.50	4.50	4.50	Se. 15, Oc. 1	0.15
Park Utah	N. Y. Curb			3⅛	Mc. 15, Ap. 1	0.15
Prince Consol.	Salt Lake	8	8	8	Nov., 1917	0.02
Silver King	N. Y. Curb			*50	Se. 20, Oc. 1	0.15
Silversmith	Spokane	*28⅛	*27½	*28	Oc. 1, Oc. 10	0.01
Tamarack-Custer	Spokane	1.41	1.38	1.41	Se. 22, Se. 29	0.25
Tintic Standard	Salt Lake	7.80	7.75	7.80	Se.1, '24, X	0.25
Utah-Apex	Boston	2⅛	2⅛	2⅛	Se.5, Se.15, Q	0.25
IRON						
Bethlehem Steel	New York	41⅞	39½	41	Jn.1, Jy.1, Q	1.25
Char. Iron	Detroit			*30		
Char. Iron pfd.	Detroit	*70	*70	*70		
Colorado Fuel & Iron	New York	41¾	38⅝	40⅜	Au.11, Au.25,Q	2.00
Col. Fuel & Iron pfd.	New York			108⅝	No.10, No.26 Q	2.00
Gt. North'n Iron Ore	New York	30⅞	29¼	30⅛	De.10, De.27	2.00
Inland Steel	N. Y. Curb			4	No.14, De.1, Q	0.62½
Mesabi Iron	N. Y. Curb			2⅞		
Replogle Steel	New York	13	11¼	12⅝		
Republic I. & S.	New York	45⅞	43	45⅝	May, 1921	1.50
Republic I. & S. pfd.	New York	83	83	83	Se.15, Oc.1, Q	1.75
Sloss-Sheffield S. & I.	New York	70⅝	68	70	Se.11, Se.20, Q	1.50
Sloss-Shef. S.&I. pfd.	New York	90⅛	90	90⅛	Se.20, Oc.1, Q	1.75
U. S. Steel	New York	110	107⅞	109⅛	No.29,De.3, QX	1.75
U. S. Steel pfd.	New York	122⅞	122	122⅛	No.4, No.29, Q	1.75
Virginia I. C. & C.	New York	36⅛	35	36⅛	De.15, Ja.2	1.50
Virginia I.C.&C.pfd.	New York			76	Jn. 17, Jy. 1	2.50
VANADIUM						
Vanadium Corp.	New York	26⅞	23½	26⅛	Jan., 1921	1.00
ARSENIC						
Western Utah Copper	N. Y. Curb	*15	*15	*15		
ASBESTOS						
Asbestos Corp.	Montreal			25	Se.29, Oc.15 Q	1.00
Asbestos Corp. pfd.	Montreal			62½	Oc.1, Oc.15, Q	1.50
SULPHUR						
Freeport Texas	New York	8⅛	7⅞	8⅛	Nov., 1919	1.00
Texas Gulf	New York	81⅞	77¼	81⅛	Se.2,Se.15, QX	1.75
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	4⅞	4⅜	4⅞		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	47¾	46½	47⅜	No.19, De.1 Q	0.75
Amer. Metal pfd.	New York			112	No.20, De.1, Q	1.75
Amer. Sm. & Ref.	New York	81	78	80⅞	Oc.17, No.1, Q	1.25
Amer.Sm.&Ref.pfd.	New York	106	105	106	No.17, De.1 Q	1.75
U. S. Sm. R. & M.	New York	34⅝	33¼	34	Jan., 1921	0.50
U.S. Sm. R.&M.pfd.	New York	45⅞	45	45⅛	Oc.9, Oc.15 Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur P. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Colorado Springs, Colorado Springs Stock Exchange.